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The Cultivated Species of the Fern Genus *Dryopteris* in the United States

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ABSTRACT.—Fifty species of *Dryopteris,* belonging to three subgenera and ten sections, are known to be in cultivation of the United States. Descriptions, cultural requirements and keys to the sections and the species are provided as an aid to the identification of these species. An addendum lists recently reported species not included in the main treatment. The species treated are:

1) *D. sieboldii*
2) *D. cycadina*
3) *D. kuratae*
4) *D. scottii*
5) *D. affinis*
6) *D. crassirhizoma*
7) *D. lepidopoda*
8) *D. polylepis*
9) *D. pseudo-filix-mas*
10) *D. wallichiana*
11) *D. celsa*
12) *D. clintoniana*
13) *D. cristata*
14) *D. ludoviciana*
15) *D. tokyoensis*
16) *D. caucasica*
17) *D. filix-mas*
18) *D. fragrans*
19) *D. goldiana*
20) *D. oreades*
21) *D. sichotensis*
22) *D. remota*
23) *D. arguta*
24) *D. juxtaposita*
25) *D. lacera*
26) *D. marginalis*
27) *D. mindshelkensis*
28) *D. stewartii*
29) *D. sublacera*
30) *D. uniformis*
31) *D. aemula*
32) *D. amurensis*
33) *D. campyloptera*
34) *D. carthusiana*
35) *D. dilatata*
36) *D. expansa*
37) *D. intermedia*
38) *D. championii*
39) *D. cystolepidota*
40) *D. decipiens*
41) *D. erythrosora*
42) *D. fuscipes*
43) *D. gymnosora*
44) *D. hondoensis*
45) *D. purpurella*
46) *D. bissetiana*
47) *D. formosana*
48) *D. sacrosancta*
49) *D. saxifraga*
50) *D. varia*

The difficulties in understanding *Dryopteris,* particularly its many species complexes, are well known to pteridologists. Work continues on the genus, and some new species and hybrids have yet to be delineated and older ones reassessed. The large number of species and the few definitive characters, often a matter of degree and normally based on the dissection of mature fronds, are problems enough without the addition of the inherent variability of the plants.

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The fronds tend to vary greatly on the same plant, and the presence of hybrids makes identification particularly troublesome. Cultivated plants compound the problem by the absence of data on their place of origin and their tendency to appear different or underdeveloped under various cultural conditions. As in most ferns, the architecture of the fronds changes as a plant matures. Juvenile plants tend to have fuller, often broader fronds with closer parts that are less divided. For instance, plants that have bipinnate fronds when mature will, in their juvenile stage, have fronds that are only once pinnate-pinnatifid. The color of the scales also darkens as the plant reaches maturity and in mature plants may be darker at the end of the season than when the fronds are young. Growing conditions, such as humidity, water and nutrient availability, influence the form of the frond. For instance, under suboptimal conditions, the apex of the pinnae can become blunter rather than acuminate; the margins entire rather than crenate or serrate, or mucronate rather than spinulose. With these numerous difficulties in mind, we hope that readers will be patient with our efforts in sorting out the cultivated species of *Dryopteris*.

The primary purpose of this paper is to provide a means of identifying the species of *Dryopteris* currently in cultivation in the United States. The emphasis of this work is on species, not infraspecific categories. Though some infraspecific categories (also particularly cultivars) are mentioned, no attempt was made to include all that are known in cultivation.

Dryopteris has ca. 225 species and is nearly cosmopolitan. The species grow in wet, shaded forests, open grassy areas, or on rocks and along streams, primarily in mountains. The greatest number of species are found in southern, southeastern, and eastern Asia.

The genus has been subdivided into 4 subgenera and 17 sections by Fraser-Jenkins (1986). Three of these subgenera and 10 of the sections are represented in cultivation in the United States. We have adopted his taxonomy, but it is beyond the scope of the present study to evaluate this classification. We have prepared a key to the Fraser-Jenkins sections known in cultivation, bearing in mind that many of the characters overlap each other. Fraser-Jenkins (1989) himself wrote that, "Each [section] contains a number of species that vary (in any parameter) so as to make even a general description of the section inapplicable in many instances though the species form natural assemblages which are separate from one another." Keys to species are provided in the treament of the sections.

Much of the complexity found in the genus is the result of hybridization. Hybrids and apogamous forms are frequent, although some of the species are fertile, sexual, diploids. The basic chromosome number for the genus is x = 41, thus sporophytes of a diploid species has two sets of 41 bivalents, or 82 total chromosomes. Other species are fertile sexual tetraploids with four sets of chromosomes, and a few are fertile sexual hexaploids. However, many of the species reproduce apogamously, rather than sexually. In the species accounts, we have taken information on chromosome numbers and sexual vs. apogamous life cycles from various literature accounts (especially Gibby, 1985)

that we have neither cited nor personally verified, and some cultivated accessions may differ from the usual chromosomal condition for a given taxon.

Sterile plants of various ploidies are produced when fertile species hybridize, and hybrids between apogamous and fertile species are possible (gametophytes of apomicts often produce viable sperm cells and can thus act as male parents). We have not detailed sterile hybrids, but growers need to be aware that such hybrids are at times found in cultivation. Sterile plants may be identified by the presence of aborted spores. Because they generally do not reproduce sexually, hybrids have either been transplanted from the wild or propagated by the subdivision of other plants. A concise illustrated treatment of the North American species of *Dryopteris* was published by Montgomery and Paulton (1981). The North American hybrids of *Dryopteris* were treated by Montgomery (1982). These publications illustrate the interrelationships of species and demonstrate the difficulties in deciphering the complexities in the group.

For the proper identification of species it is important to have an entire fertile frond from a mature, well developed plant. This should include the entire stipe (petiole) together with its scales and the scales at the very base of the petiole as well as those from the rhizome. The characters important for the identification of the species include: the size and arrangement of the fronds; the relative length and color of the petiole; the density, shape, and color of the scales, hairs or glands; the size, color, texture, and overall shape of the blade and the pattern of its dissection; the shape and pattern of dissection of the pinnae, pinnules, and ultimate segments, particularly of the lowermost pinnae and the lowermost pinnule next to the rachis, and the nature of the margins; the position of the sori on the pinnae; the presence or absence of an indusium; and, when present, the nature of the indusium itself. Of these, the two crucial characteristics are the shape and cutting of the ultimate segments and the color and shape of the stipe-base scales. In general, in this account the description of the dissection of the blade is that exhibited by the lowermost (basal) pinnae; it is common to find that the degree of dissection of the pinnae decreases the closer they are to the tip of the blade. We believe that the illustrations of the species provide the best tools for initial identification. The preliminary determination should be confirmed by checking the specimen against the written description. Even in listing the species, it is not possible to treat each one fully. The search for new garden ferns is an active pursuit, and new species are continually being introduced, making it impossible for us to include all of them.

More cultural information may be found in horticultural books. Most *Dryopteris* species are terrestrial and adapt to garden soils with a generous amount of humus. Most grow well in moist soil. Even those species known for preferring wet areas will adapt to growing in moist, better drained soil. Most species are more luxuriant with ample humidity. In more arid climates, periodic misting during periods of low humidity will produce more handsome foliage. Some species seem to grow best in acidic soil or basic soil, but most grow in the neutral or slightly acidic range. Partial, but not deep, shade suits most species of *Dryopteris*.

Many temperate deciduous species do not grow well in warmer climates such as southern California, whereas most temperate evergreen species (mostly those in the subgenus *Erythrovariae*) do well in these climates. The limiting factor is often the temperature tolerances of the species, particularly the minimum. Where information on temperature is given as the *January average,* this number represents the temperature mean for that month and is taken from isotherm maps from the area where the fern is native. Please note that this number is an approximation and it does not represent the minimum temperature for each species. The minimum temperature tolerances of the more recently introduced species are still being gathered, but such information may be found in the publications of various fern societies and horticultural literature. Remember that even though a plant may survive its minimum temperature in winter, it may be vulnerable when subject to the same or slightly higher temperature in the spring, particularly if new growth has emerged. Data on the tolerance of temperate climate ferns to subtropical and tropical conditions is also incomplete and is affected by many variables.

Dryopteris Adans.—Shield fern, buckler fern, wood fern.

Plants terrestrial. Rhizome thick, suberect or erect, less commonly creeping, surrounded by close, spirally arranged leaves and old leaf bases; rhizome scales nonclathrate. Leaves usually in a rosette; stipe grooved, scaly, with 3–7 (9–10) vascular bundles arranged in a C-shaped pattern; blades 1–4 times pinnately compound, bearing scales but lacking needlelike hairs, the pinna midribs grooved. Sori round, dorsal; indusium kidney-shaped, attached at a sinus, rarely absent.

This genus of ca. 225 species is cosmopolitan, occurring mostly in temperate forests and montane areas of the tropics. The species are difficult to identify simply because there are so many of them, and there are many similar groups of species. Furthermore, the fronds can vary even on the same plant. Identification requires careful examination of large, mature leaves. About 50 species are in cultivation in the United States, but new species are constantly being added to the trade and older ones are disappearing.

The species of *Dryopteris* pose no special problems in cultivation, except that some of the species native to colder climates do not adapt well to warm-climate gardens and some species thrive only in acidic soils. Most species are easy to propagate from spores or divisions. Offshoots come from the base of erect rhizomes, semi-erect rhizomes or branches of short-creeping rhizomes. Generally, species that are deciduous in cold temperate climates tend to be more evergreen in warmer climates. Fronds that become deciduous wither in place but may or may not promptly lose their green color.

The groups used in this treatment are the subgenera and sections of *Dryopteris* recognized by Fraser-Jenkins (1986).

Key to the Subgenera and Sections of *Dryopteris*

This key is provided as a rough guide to the sections of the genus. We recognize that many characters of the sections overlap each other and that place-

ment in a section may be difficult. We have found that the illustrations provide one the most rapid and reliable guides to identification of specimens, followed by a confirmation against the written description. Please consult the introduction for some guidelines on identification.

1. Fronds pinnate with the terminal segment like the lateral ones . . . . Subgenus 1. *Pycnopteris*
1. Fronds pinnate or more divided, the apex divided
   2. Fronds with very small bullate or bullate-based scales on the underside of the rachis, costae or costules . . . . . (Subgenus 3. *Erythrovariae*)
      3. Basiscopic pinnule on the lowest pinnae shorter than the adjacent pinnules (sometimes equal or slightly longer in *D. cystolepidota*) . . . . . Section 3.1. *Erythrovariae*
      3. Basiscopic pinnule of lowest pinnae noticeably longer than the adjacent pinnules . . . . . Section 3.2. *Variae*
   2. Fronds without bullate or bullate based-scales on the underside of the rachis, costae, or costules . . . . . (Subgenus 2. *Dryopteris*)
      4. Fronds once pinnate, the pinnae only shallowly lobed or lobed only half way or less to the costae, rarely cut to the costae at the pinnae base . . . . . Section 2.1. *Hirtipedes*
      4. Fronds fully pinnate-pinnatifid to 3(4)-pinnate
         5. Fronds mostly 3-pinnate
            6. Stipe scales narrow-lanceolate, matt and concolorous; blade triangular-ovate; stipe dark purple-brown at base (*D. aemula*) . . . . . Section 2.7. *Aemulae*
            6. Stipe scales ovate-lanceolate, mostly glossy and usually bicolorous; blade broader, pentangular, triangular or triangular-lanceolate . . . . . Section 2.8. *Lophodium*
         5. Fronds mostly pinnate-pinnatifid to 2-pinnate
            7. Fronds mostly pinnate-pinnatifid though bases of some pinnae may be pinnate . . . . . Section 2.3. *Pandae*
            7. Fronds nearly 2-pinnate to fully 2-pinnate
               8. Fronds thin-coriaceous, dark green, glossy above, the segments or pinnules regularly rectangular, the margins not toothed . . . . . Section 2.2. *Fibrillosae*
               8. Fronds herbaceous, not dark green, matt, segments or pinnules not regularly rectangular, the sides mostly tapering, the margins entire, lobed or toothed
                  9. Pinnules stalked or with narrow base in basal half of the pinnae, the segments or pinnules entire, lobed or with short acute teeth . . . Section 2.6. *Pallidae*
                  9. Pinnules not stalked nor narrowed at base in basal half of the pinnae; sides and apex of the segments or pinnules with long acute teeth
                     10. Frond linear-lanceolate to lanceolate (broader in *D. goldiana*); scales mostly lanceolate to ovate-lanceolate . . . . . Section 2.4. *Dryopteris*
                     10. Frond narrowly triangular-lanceolate; scales triangular-lanceolate, light brown, their bases often dark (*D. remota)* . . . . . Section 2.5. *Remotae*

Subgenus 1. Pycnopteris (T. Moore) Ching

Blade firm-textured, pinnate, the terminal segment resembling the lateral ones.

1. Dryopteris sieboldii (Van Houtte ex Mett.) Kuntze (Rev. Gen. Pl. 2:813. 1891).—Fig. 1.

Rhizome erect, more or less stout. Stipe ca. 40 (30–60) cm long, densely scaly at the base, sparsely so above, the scales narrow triangular to ovate triangular, subentire to sparsely fimbriate or distantly dentate, dark brown, the rachis sparingly fibrillose-scaly; blade pinnate (young fronds often simple and

FIG. 1. *Dryopteris sieboldii.* A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

cordate) with the apex ending in a terminal pinna like the lateral pinnae, ca. 50 cm long, 37 cm wide, pinna pairs mostly 3 (1–5), pale green beneath, coriaceous-chartaceous; pinnae broadly linear-lanceolate, 18–30 cm long, 3.5–6 cm wide, base slightly cordate to rounded, sometimes oblique, margins slightly serrate or crenate, sometimes shallowly lobed with the lobes serrate. Sori large, in 2–3 series next to the costa, mostly absent from the marginal and submarginal area; indusia large, entire, thin.

Dryopteris sieboldii is native to eastern Asia, where it is common in wooded ravines. This tetraploid, sexual species is distinct in having an apical pinna similar to the lateral ones and with few large lateral pinnae. Although slow growing in cultivation, plants may reach 40 cm or more in height. The spreading fronds are coarse and few but tend to form a clump and could be used as an accent in the landscape. Slightly undulating and lobed margins tend to develop in cultivated plants. The plant is hardy to a winter minimum average of ca. 35°F. Semi-deciduous, nearly evergreen in southern California.

Subgenus 2. Dryopteris

Blade variously dissected, the pinnae gradually reduced to a pinnatifid apex; scales not bullate.

Section 2.1. Hirtipedes Fraser-Jenk.

Fronds pinnate to pinnate-pinnatifid, if pinnate pinnatifid then usually cut half way or less to the costa (except sometimes more deeply cut on the proximal pinnae at their bases).

KEY TO SPECIES OF SECTION *HIRTIPEDES*

1. Indusia absent . . . . . 4. *D. scottii*
1. Indusia present
   2. Pinna margins cut mostly less than ⅓ way to the costa, the stipe scales dense and shaggy, the sinuses narrow between shallow lobes . . . . . 2. *D. cycadina*
   2. Pinna margins cut half way to the costa, the stipe scales not conspicuously dense and shaggy, the sinuses V-shaped between spreading lobes . . . . . 3. *D. kuratae*

2. Dryopteris cycadina (Franch. & Sav.) C. Chr. (Index Filicum 260. 1905).—Shaggy wood fern, black wood fern.—Fig. 2.

D. hirtipes (Bl.) Kuntze, misapplied

D. atrata (Kunze) Ching, misapplied

Rhizome erect, stout, infrequently producing offshoots. Stipe stout, to ca. 30–40 cm long, very scaly at the base, less so above, the scales narrowly triangular, 10–15 mm long, dark brown to black, margins sparsely slender toothed, apex attenuate, the rachis scales smaller and narrower, some fibrillose-scaly; blade pinnate, oblong-lanceolate, 50–70 cm long, 20–35 cm wide, pinnae pairs ca. 30, texture thin-leathery; pinnae narrow ovate to long narrow triangular, the base more or less truncate-cordate, sessile or short-petiolate, the margins coarsely serrate to crenate or lobed ca. ¼–⅓ way to the costa, the serrations broad and often ending in 1 or 2 small teeth, the proximal pinnae sometimes deeply pinnatifid at their base. Sori 2–6 per segment, absent from the marginal and submarginal area; indusia large, entire, persistent. Basal pinna pair tending to angle forward and often downward from the adaxial surface of blade; pinnae (proximal) often falcate.

FIG. 2. *Dryopteris cycadina*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Medial pinna [scale=5mm].

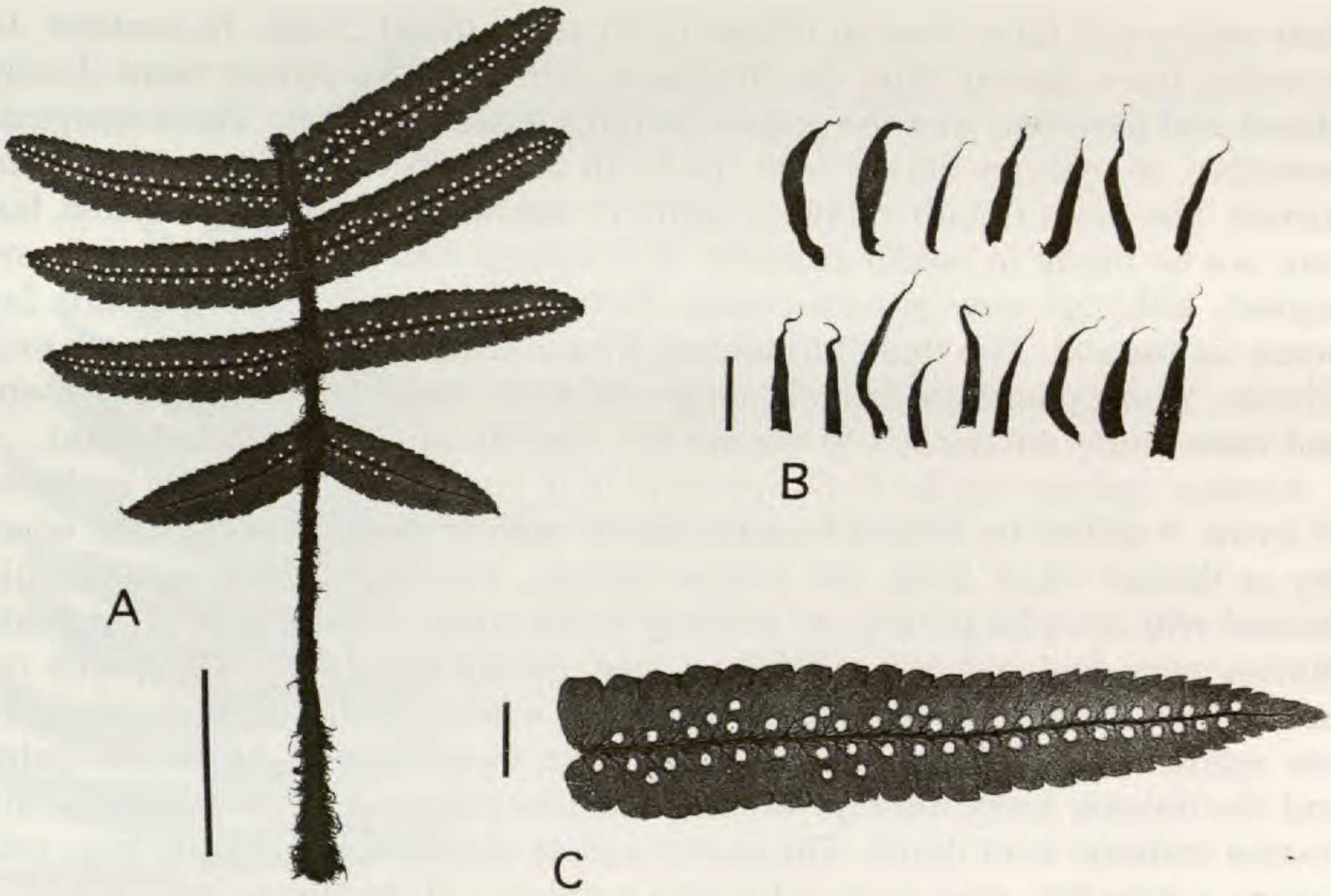


FIG. 3. *Dryopteris hirtipes.* A) Frond base [scale=5cm]. B) Stipe scales [scale=5mm]. C) Medial pinna [scale=5mm].

Dryopteris cycadina may reach 30–100 cm in height but is usually rather small. The somewhat leathery, sometimes crisped fronds spread and form a whorl; longer fronds may arch slightly. The species is hardy to a January average of 35°F; fronds do not wither and brown quickly, but remain green for some time and tend to lie prone on the soil during the winter. The edges and tips of the fronds often abort in more arid climates, otherwise the plant is easily cultivated.

Dryopteris cycadina is an apogamous triploid fern native to Japan and eastern China, where it is abundant on wooded hillsides at ca. 1,400–2,700 m. It may circulate in horticulture as *D. hirtipes* or *D. atrata* under which names it was previously known in Japan. All three names have been much confused in the botanical literature as well and the entire group is in need of detailed study. As presently interpreted (Fraser-Jenkins 1989), *D. hirtipes* is a separate species and *D. atrata* is one of its subspecies (*D. hirtipes* ssp. *atrata* (Kunze) Fraser-Jenk.); it is uncertain that any of these plants is cultivated in the U.S.

It is uncertain if *D. hirtipes* (Blume) Kunze from Southeast Asia is actually in cultivation. A plant rarely in cultivation and very tentatively identified as *D. hirtipes* (Fig. 3) has been circulating under the misapplied names of *D. darjeelingensis* Fraser-Jenk. and *D. stenolepis* (Baker) C. Chr. [*D. gamblei* (C. Hope) C. Chr.]. True *D. hirtipes* is described as having fronds to 60 cm long, the stipe ca. half the length of the blade, the blade with up to 25 pairs of pinnae, the pinna margins toothed or lobed, and the sori indusiate. The marginal lobes, varying from shallow to more extended, are usually truncate at

their apices and often bear an obtuse tooth at the distal corner. In contrast, *D. cycadina* has a shorter stipe, ca. 30 pinnae pairs with the pinnae more closely placed and narrower, and the pinnae margins truncate-serrate. These marginal serrations are oblique-falcate with the tooth at the distal corner acute and incurved. The plant in cultivation is hardy in the Seattle, Washington, area, but may not be hardy in colder climates. In southern California gardens it is evergreen, although new growth ceases during the winter and old fronds lay prone on the soil. The tips of unfolding fronds tend to abort in this more arid climate. Young plants are eaten by slugs and snail. Better herbarium specimens and more study are needed to resolve the identity of this cultivated plant.

Another species similar to *D. cycadina* is *D. commixta* Tagawa, an endemic of Japan. It differs by having broader fronds with an herbaceous texture when dry or thicker when fresh, the pinnae stalked, 1–2.5 cm broad, more deeply incised with broader pinnae cut halfway to the costa, usually with 20 or fewer pinnae-pairs, and indusia variable in size, poorly developed. *Dryopteris cycadina* has, in contrast, narrower fronds with a more leathery texture, the pinnae sessile, 1–2 cm broad, shallowly incised, usually to ca. 30 pinnae-pairs, and the indusia fairly uniform in size. The identification of the currently cultivated material is in doubt. The senior author observed that fronds from submature plants that were received from a grower as *D. commixta* were indistinguishable from *D. cycadina* when the plants were mature.

Another garden species similar to *D. cycadina* is *D. namegatae* (Sa. Kurata) Sa. Kurata from Japan and China. It is thought to be a hybrid, as it appears intermediate between *D. cycadina* and *D. dickinsii* (the latter discussed under *D. kuratae*). *Dryopteris namegatae* is distinguished from *D. cycadina* by the veins and their branches being depressed below the adaxial surface of the blade and the presence of shorter basal pinnae. On our cultivated plants the proximal pinnae may bear on their acroscopic side next to the rachis a roundish to truncate lobe that may be free nearly to the pinnae midrib. The plant is evergreen, as described above in *D. hirtipes,* and is hardy along the western coast of the U.S., although the frond tips tend to abort in southern California gardens.

3. Dryopteris kuratae Nakaike ex Hoshiz. & K.A. Wilson, sp. nov.—TYPE: Japan, cultivated in Tokyo, originally from Kagoshima Pref., Mt. Takakuma, Osumi Peninsula, 25 July 1959, *S. Kurata* s.n. (TNS #146476; photo Nakaike, New Fl. Jap. Pterid. 430. 1992).—Fig. 4.

Planta *D. pycnopteroidi* (Christ) C. Chr. similis, sed paleis stipitis et rachidis brunneis usque atro-brunneis, marginibus pinnarum ⅓ ad ½ ad costam lobatis, apicibus loborum plerumque obtusis et obliquis, sinubus inter lobos plerumque V-formibus, soris plerumque ad apices loborum absentibus et tantum aliquando juxta costam praesentibus differt.

Rhizome erect, producing offshoots. Stipe moderately scaly, the stipe and rachis scales mostly brown to blackish brown, narrow triangular to lanceolate, acuminate, irregularly toothed; blade pinnate, oblanceolate, ca. 50 cm long, 15

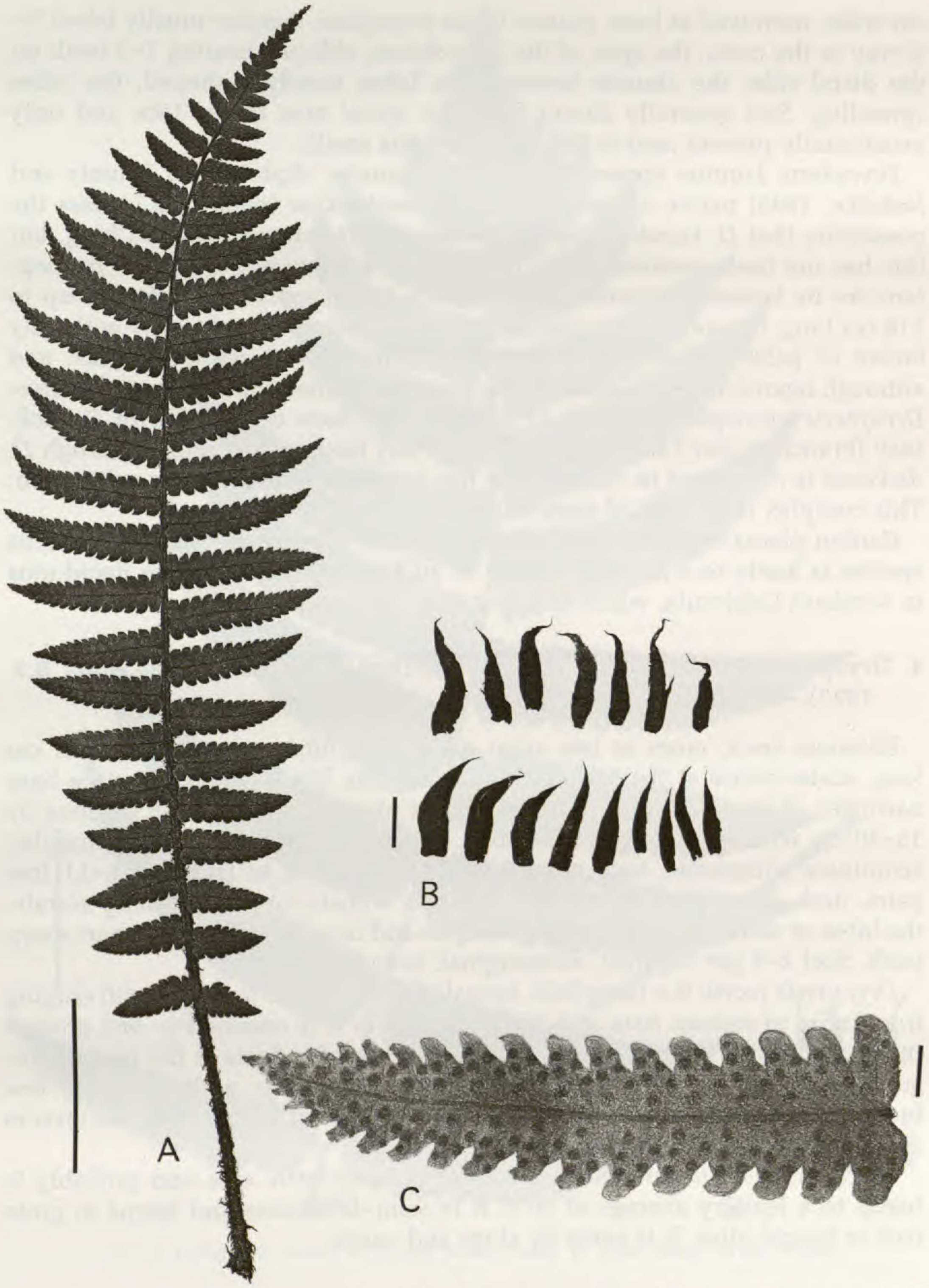


FIG. 4. *Dryopteris kuratae*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Medial pinna [scale=5mm].

cm wide, narrowed at base, pinnae linear-triangular, margins mostly lobed ⅓–½ way to the costa, the apex of the lobe obtuse, oblique, bearing 1–3 teeth on the distal side, the sinuses between the lobes mostly V-shaped, the lobes spreading. Sori generally absent from the apical area of the lobe and only occasionally present next to the costa; indusia small.

Dryopteris kuratae apparently is an apogamous diploid fern (Kurata and Nakaike, 1985) native to eastern Asia. Fraser-Jenkins (pers. com.) raises the possibility that *D. kuratae* may be the same as *D. hangchowensis* Ching, but this has not been resolved. Until recently, *D. kuratae* was called *D. pycnopteroides* by Japanese botanists, but this is a larger species with fronds up to 110 cm long, the sori more costal, and the rachis more densely scaly with only brown or paler scales. True *D. pycnopteroides* is from western China, and although reported to be cultivated, the plants examined thus far are *D. kuratae*. *Dryopteris pycnopteroides* and *D. kuratae* have been confused with *D. dickinsii* (Franch. & Sav.) C. Chr., which lacks sori next to the costa. Although *D. dickinsii* is cultivated in Australia, it has not been found in U.S. cultivation. This complex is in need of more study.

Garden plants reach ca. 60 cm in height with many spreading fronds. This species is hardy to a January average of 30°F and slowly becomes deciduous in southern California, where it grows well. It is easily cultivated.

4. Dryopteris scottii (Bedd.) Ching (Bull. Dept. Biol. Sun Yatsen Univ 6:3. 1933).—Fig. 5.

Rhizome erect, more or less stout, producing offshoots. Stipes 25–45 cm long, scales dense at the base, narrow-triangular, black, above the stipe base narrower, shorter and more scattered; blade pinnate, ovate, 25–35 cm long by 15–30 cm wide, apex amply foliaceous, base broad; pinnae narrow-triangular, acuminate, subsessile, base mostly oblique, round or to truncate, 6–11 free pairs, dark green, firm herbaceous, margins crenate-lobed to distally serrate, the lobes or serrations oblique at their apex and usually with 1 or 2 short sharp teeth. Sori 2–6 per segment, submarginal; indusia absent.

Dryopteris scottii is a tetraploid, sexual species (Fraser-Jenkins 1989) ranging from India to eastern Asia and Malaysia, where it is common in wet ground in dense forest at ca. 900–2,000 m. The absence of indusia is the best distinguishing character of *D. scottii*. The broad ovate blade with relatively few broad pinnae with roundish lobes, lightly scaly rachis, and herbaceous texture are also helpful distinguishing features.

Dryopteris scottii grows well outdoors in the Seattle area and probably is hardy to a January average of 50°F. It is semi-deciduous and seems to grow best in humid sites. It is eaten by slugs and snails.

Section 2.2. Fibrillosae Ching

Like Section *Hirtipedes* except the pinna lobes cut nearly to the costa, leaving them connected by a narrow wing of tissue, fronds more or less linear-

FIG. 5. *Dryopteris scottii*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

lanceolate, the pinnae segments or lobes are quite regular, rectangular, their sides parallel and untoothed, their apices truncate or rounded-truncate and bearing short teeth.

KEY TO SPECIES OF SECTION *FIBRILLOSAE*

1. Blade oblong triangular, the basal pinnae ca. equal to or longer than those above. . . . . 7. *D. lepidopoda*
1. Blade ovate to lanceolate or oblanceolate, or elliptic, the basal pinnae shorter than those above
   2. Veins of segments simple except for the basiscopic segments next to the rachis . . . . . 8. *D. polylepis*
   2. Veins of segments forked
      3. Black blotch or spot present at base of pinna midrib on abaxial side
         4. Basal basiscopic pinnule next to the rachis with sides entire to subentire (rarely elongate and to shallowly pinnatifid in ssp. *borreri*); the black blotch at base of pinna midrib on the abaxial side not fading in dried fronds; scales on abaxial side of pinna midrib mostly tan (concolorous), commonly cultivated species with many cultivars . . . . . 5. *D. affinis*
         4. Basal basiscopic pinnule next to the rachis slightly elongate, lobed to shallowly pinnatifid in mature plants, black blotch at base of pinna midrib on abaxial side fading away on dried fronds, scales on the abaxial side of the pinna midrib mostly dark brown to black with pale margins, infrequently cultivated species . . 9. *D. pseudo-filix-mas*
      3. Black blotch or spot absent from base of abaxial side of pinna costae
         5. Blade lustrous, firm; the segment apex typically truncate with larger teeth at the distal corner, the veins on the abaxial surface of segments conspicuous . . . . . 10. *D. wallichiana*
         5. Blade not lustrous, firm-herbaceous, the segment apex typically rounded with the teeth on both sides similar, the veins on the abaxial surface not particularly conspicuous.
            6. Sori on distal pinnae of frond; basal basiscopic pinnule (segment) next to rachis adnate; lateral margins of segment weakly crenate, abaxial side of pinna midrib with many long tapered triangular scales and hair-like scales, scales shaggy, pale tan . . . . . 6. *D. crassirhizoma*
            6. Sori extending to middle of frond or lower; basal basiscopic pinnule next to rachis sessile; lateral margins of segment notched-serrate, abaxial side of pinna midrib with mostly deltoid to triangular scales, many with an abruptly acuminate apex, scales dark brown to black often with pale margins . . . . . 17. *D. filix-mas* (see section *Dryopteris*)

5. Dryopteris affinis (Lowe) Fraser-Jenk. (Fern Gaz. 12:56. 1979).—Yellow golden-scaled male-fern, scaly male-fern, common golden-scaled male-fern.—Fig. 6.

D. abbreviata (DC.) Newman ex Manton, *non* (Schrad.) Kuntze
D. pseudomas (Woll.) Holub & Pouzar

Rhizome erect, producing offshoots. Stipe 1/6–1/4 the blade length, stipe and rachis densely scaly, scales mostly ovate-lanceolate, usually gold-brown often darker at the base; blade pinnate-pinnatifid or to 2-pinnate at the base next to the rachis, mostly lanceolate, to ca. 100 cm long, 30 cm wide, dark bluish green, new growth yellow-green, leathery; pinna costae on underside next to the rachis usually with a blackish blotch, the costal scales lanceolate; pinnules often lobed or slightly auriculate at the base, lowest basiscopic pinnule next

FIG. 6. *Dryopteris affinis*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Pinnules from medial pinna [scale=5mm].

to the rachis adnate to the costa on distal side or winged to the next pinnule; segments parallel sided and subentire, margins slightly recurved, segment apex usually obtuse to subtruncate and bearing wide-based but acute to obtuse pointed teeth. Sori medial; indusia thick and when young with margins tucked under sorus.

Dryopteris affinis is native to Europe to the Caspian Sea and northwest Africa. This species is best recognized by the dark blotch on the underside of the costa next to the rachis, although it is absent on a plant reportedly from Madeira, and may fade in dried specimens of ssp. *borreri* (Newman) Fraser-Jenk. It may be faintly present on sun-exposed, old, leathery fronds of *D. filix-mas,* and is present on fresh fronds of *D. pseudo-filix-mas.* Should fronds of *D. filix-mas* have faint blotches, they may be separated by its slightly tapered segments with sharper teeth extending down the sides of the segment and the stipe and rachis scales that are pale, thin, membranous and variable in width. In southern California, *D. filix-mas* also tends to become deciduous much earlier than does *D. affinis. Dryopteris pseudo-filix-mas* may be separated from *D. affinis* by the characters in the key.

Dryopteris affinis is a very difficult species complex and the delineation of its many variants is quite controversial. Some botanists maintain an informal approach and designate the variants as morphotypes, whereas others take a more formal approach and designate them as subspecies. Even with experience, most variants are difficult to separate. For more details on the subspecies or morphotypes, see Jermy and Camus (1991), Stace (1989), Fraser-Jenkins (1982, 1996), Hutchinson and Thomas (1996), Dyer (1996), Jermy (1996), and Piggott (1997).

Studies on *D. affinis* subspecies (or morphotypes) are incomplete and emphasize mostly British natives. The native origin of cultivated plants is usually unknown and some may be subspecies different from the British natives. Therefore the following treatment of the cultivated plants should be regarded as tentative.

The following subspecies and hybrids have been found in U.S. cultivation and most grow well in southern California:

5.1 Dryopteris affinis ssp. affinis.—Western scaly male fern.

Description and distribution the same as for the species. Stipe scales dense, deep gold to dark gold; blade glossy, thin-leathery, base more or less tapering; segment apex rounded with obtuse to slightly acute teeth; indusia thick, well tucked under the sporangia, not shriveling but lifting slightly at maturity. Attractive for its densely scaly stipe, glossy dark bluish-green colored fronds. Particularly noticeable is the yellow-green color of new growth. Diploid, apogamous. It is hardy to a January average of 25°F, deciduous to semi-deciduous, the old fronds often lasting until spring, easily cultivated.The plant circulating among gardeners as *D. affinis* from Madeira is distinct by the absence of a dark spot at the base of the pinna costa on the abaxial side, and the presence of very minute glands on the indusial margin and on the tissue protruding from

the upper surface of the indusium near the center. These observations were made on plants growing in southern California. It is uncertain what the taxonomic status of this plant is. It is a sturdy grower and tends to produce a stout rhizome bearing fronds in a well defined fascicular pattern. The stipes are noticeably short and thick. The spores were reportedly collected by Clive Jermy in Madeira, Spain, and were originally grown and distributed by Judith Jones.

5.2. Dryopteris affinis ssp. borreri (Newman) Fraser-Jenk. (Willdenowia 10: 110. 1980).—Borrer's scaly male fern, common scaly male fern.

Stipe scales moderately dense, pale straw to mid brown with dark bases; blade slightly glossy, base truncate; segment apex squarely truncate to more pointed with sharp acute teeth frequently longer at the corners (resembling cat's ears) rarely with the lowest basiscopic pinnule next to the rachis elongate and pinnatifid; indusia thin, with partial flat rim, lifting into a disc, then into a cone at maturity. Same range as ssp. *affinis*. Triploid (*2n*=123), apogamous, culture as for the ssp. *affinis*, fronds dying back progressively through the winter.

5.3. Dryopteris affinis ssp. cambrensis Fraser-Jenk. in L.N. Derrick, Jermy & A.M. Paul (Sommerfeltia 6:xi. 1987).—Narrow scaly male fern.

Stipe scales, dense, ginger to reddish gold; blade slightly glossy, narrowly elliptic to oblanceolate, base tapering, segment apex rounded-truncate to more pointed with slightly obtuse to acute teeth; indusia thick, with margins just enclosing the sporangia, shriveling and lifting to form a cone upon maturity. Range same as for the species except absent in parts of central and S. Europe. Triploid (*2n* = 123), apogamous, culture as for ssp. *affinis*, fronds dying back rapidly after first frost.

5.4. Dryopteris ×complexa Fraser-Jenk. in L.N. Derrick, Jermy & A.M. Paul (Sommerfeltia 6:xi. 1987).

Stipe scales moderately dense, brown; blade lanceolate to ovate-lanceolate, matte, base slightly narrowed, truncate, pinnae outline somewhat uneven, segment margins shallowly crenate-lobed or toothed, segment apex round-truncate; indusia shriveling and lifting to form a distorted cone when mature, spores mostly aborted. A hybrid of *D. affinis* × *filix-mas*. Range uncertain, probably where both parents exist. Tetraploid (2*n*=164), apogamous. Widely sold in the trade as *D. filix-mas undulata robusta* (sometimes as *D. affinis* × *filix-mas* 'Robust' or *D. undulata*). Culture as for ssp. *affinis*, semi-deciduous. Vigorous growing, producing many fronds with pinnae often overlapping slightly to give a full foliaceous appearance.

In addition, the following cultivars have been found in the U.S. trade:

Dryopteris affinis 'Congesta Cristata'. Fronds dwarf to 23 cm, congested and crested.

Dryopteris affinis 'Crispa'.—Frond dwarf and broad, to 20 cm long and 14 cm wide, crisped and congested, the segments held in different planes or somewhat twisted giving an irregular outline; from ssp. *affinis*. Plants by this name in the current trade are normal sized with segments twisted.

Dryopteris affinis 'Crispa Gracilis'.—Dwarf, congested, upright leathery fern with the pinnae apices curved and hook-like. It has similar culture requirements to ssp. *affinis,* from which it originated. Probably the same as the plant sold in the Dutch trade as *D.* 'Crispa Congesta' or *D.* 'Congesta Crispa'.

Dryopteris affinis 'Cristata' ('Cristata The King').—Fronds to 120 cm, arching blade apex and pinnae each ending in a tassel; from ssp. *affinis.*

Dryopteris affinis 'Cristata Angustata'.—Like cv. Cristata except narrower and smaller, to ca. 45 cm long by 5 cm wide; from ssp. *affinis*. Current trade material by this name reaches 80 cm by 7 cm.

Dryopteris affinis 'Grandiceps'.—Frond apex wih a heavy terminal crest.

Dryopteris affinis 'Polydactyla'.—A group of crested forms with flat tassels on the pinnae tips and 2 large crests on the blade apex.

Dryopteris affinis 'Revolvens'.—Tips of pinnae recurved, fronds to 100 cm.; from ssp. *borreri.*

Dryopteris affinis 'Stableri'.—Erect to slightly arching, narrow fronds, to 1 m. Reported to be a hybrid between *D. affinis* var. *affinis* 'Pinderi' (an abnormal narrow form of the species) and *D. filix-mas* (Fraser-Jenkins, 1996)).

Dryopteris affinis 'Stableri Crisped'.—Very upright narrow fronds of medium height, margins crisped.

6. Dryopteris crassirhizoma Nakai (Cat. Sem. Hort. Bot. Univ. Imp. Tokyo 32. 1920).—Fig. 7.

Rhizome erect, stout, may produce offshoots. Fronds to ca. 150 cm long, 30 cm wide. Stipe short, ⅓–⅕ the length of the blade, fasiculate, densely covered with mid-brown to reddish brown scales, the larger scales thin, glossy, firm membranous, usually reddish brown, linear, lanceolate to ovate, attenuate, to 30 mm long or more; blade mostly oblanceolate, gradually narrowed below, deeply pinnate-pinnatifid next to the rachis in the proximal part of the frond; pinnae linear-lanceolate, basal pair usually more triangular but equilateral, underside of the costa next to the rachis with costal scales tan, triangular, variable, larger ones mostly attenuate, kinky; segments (pinnules) typically closely placed, narrowly oblong, weakly falcate, their apices mostly blunt-rounded, dentately toothed or untoothed, segment side margins mostly weakly crenate, lowest basiscopic segment (pinnule) next to the rachis not free and its side margins subentire. Sori medial, borne on distal part of frond.

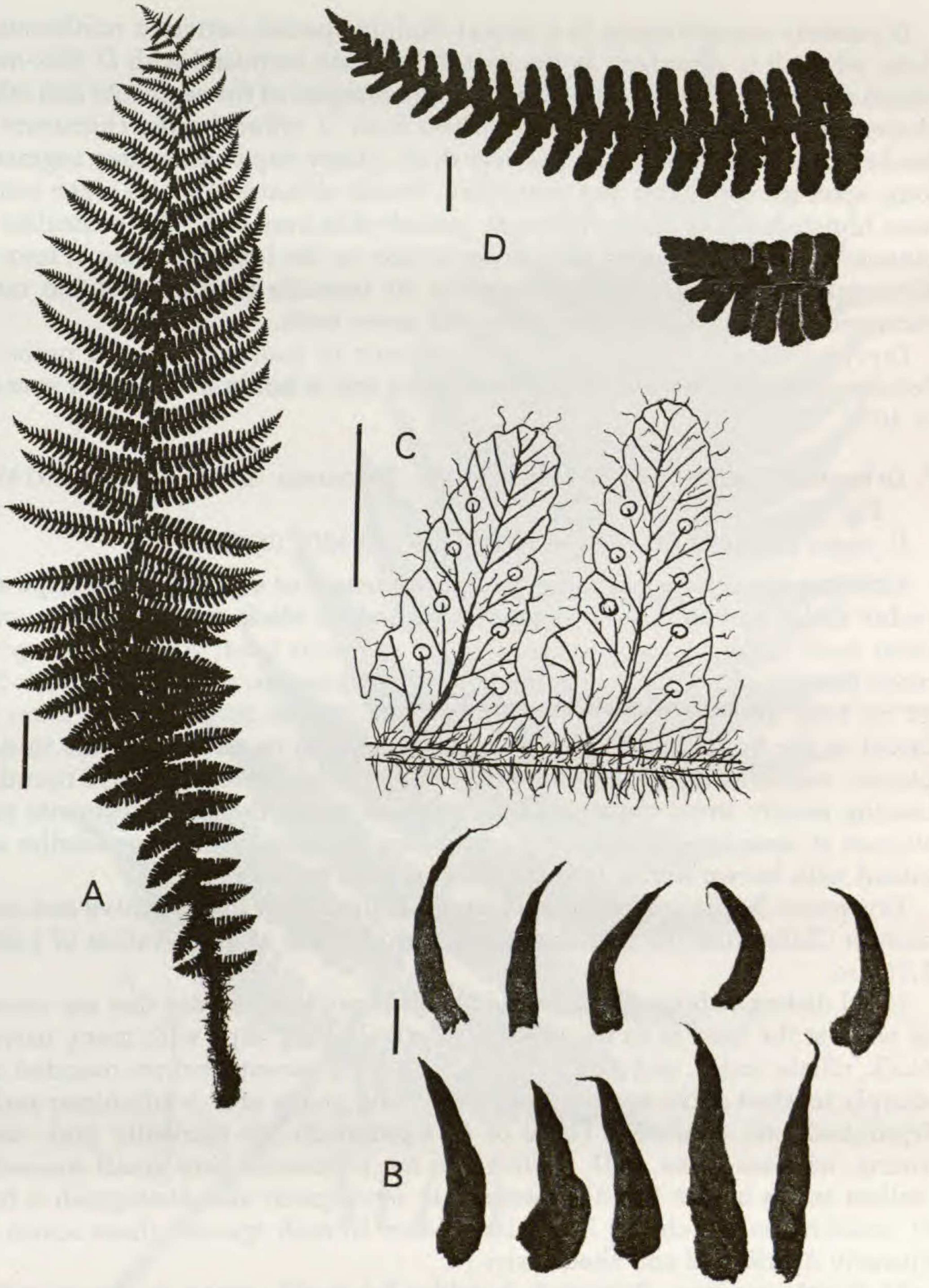


FIG. 7. *Dryopteris crassirhizoma*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Pinnules [scale=1cm], D) Medial pinna above, distal pinna below [scale=1cm].

Dryopteris crassirhizoma is a sexual diploid species native to northeastern Asia, where it is abundant. In the past, it has been confused with *D. filix-mas,* which differs by having teeth along the side margins of the segments and other characters in the key. This species differs from *D. affinis* by the characters in the key, and *D. crassirhizoma* has very thick, glossy stipe base scales, segments long, apex mostly round and untoothed, fronds oblanceolate and green rather than bluish-green in color. When *D. pseudo-filix-mas* lacks the pinnatifid or pinnate basiscopic pinnule next to the rachis on the lowest pinnae, it may be distinguished from *D. crassirhizoma* by its truncate to acute pointed more rectangular pinnules with side lobes and acute teeth.

Dryopteris crassirhizoma is semi-deciduous in cool winters and probably deciduous in cold winters. It is easy to grow and is hardy to a January average of 30°F.

7. Dryopteris lepidopoda Hayata (Icon. Pl. Formosan. 4:161, fig. 101. 1914).—Fig. 8.

D. nigra Ching (Bull. Fan Mem. Inst. Biol. 8:430. 1938).

Rhizome erect. Stipes usually ½ the blade length or equal to it, the stipe and rachis scales narrow long-triangular, brownish to black, margins ciliate, cilia often more numerous and longer towards the scale base; young fronds pink; blade pinnate-pinnatifid to 2-pinnate next to the rachis, oblong-triangular, 25–40 cm long, 10–20 cm wide, slightly lustrous, pinnae mostly falcate often deflexed at the frond base, acuminate; lowest pinnae ca. as long as the middle pinnae; segments (or pinnules) oblong, many, close, spreading, apex rounded, bearing mostly small narrow-triangular acute teeth, the basal segments constricted at their base; pinna costa scales like the rachis scales but smaller and mixed with brown fibrils. Indusia thick, mostly persistent.

Dryopteris lepidopoda is an apogamous diploid fern that is native and common in China from the Himalayan region to Taiwan at an elevation of 1,200–1,550 m.

Good distinguishing characters of *D. lepidopoda* are blades that are usually as wide at the base as in the middle, relatively long stipe with many narrow, black, ciliate scales, and many oblong, lustrous segments that are rounded and sharply toothed at the apex. Sometimes young plants of *D. wallichiana* and *D. lepidopoda* are confused. Those of *D. lepidopoda* are markedly pink when young, whereas those of *D. wallichiana* are yellowish. Very small somewhat stellate scales on the frond surfaces of *D. lepidopoda* also distinguish it from *D. wallichiana* which has lanceolate scales. In both species, these scales are sparsely distributed and shed early.

In Seattle gardens, *Dryopteris lepidopoda* usually grows to 60 cm tall, is evergreen, and probably hardy to a January average of ca. 45°F or lower.

8. Dryopteris polylepis (Franch. & Sav.) C. Chr. (Index Filicum 285. 1905).—Fig. 9.

Rhizome erect. Stipe ca. ⅕ the blade length, stipe scaly, the scales narrow triangular to ovate, blackish, the margins stiff, ciliate to fimbriate to just below

FIG. 8. *Dryopteris lepidopoda*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

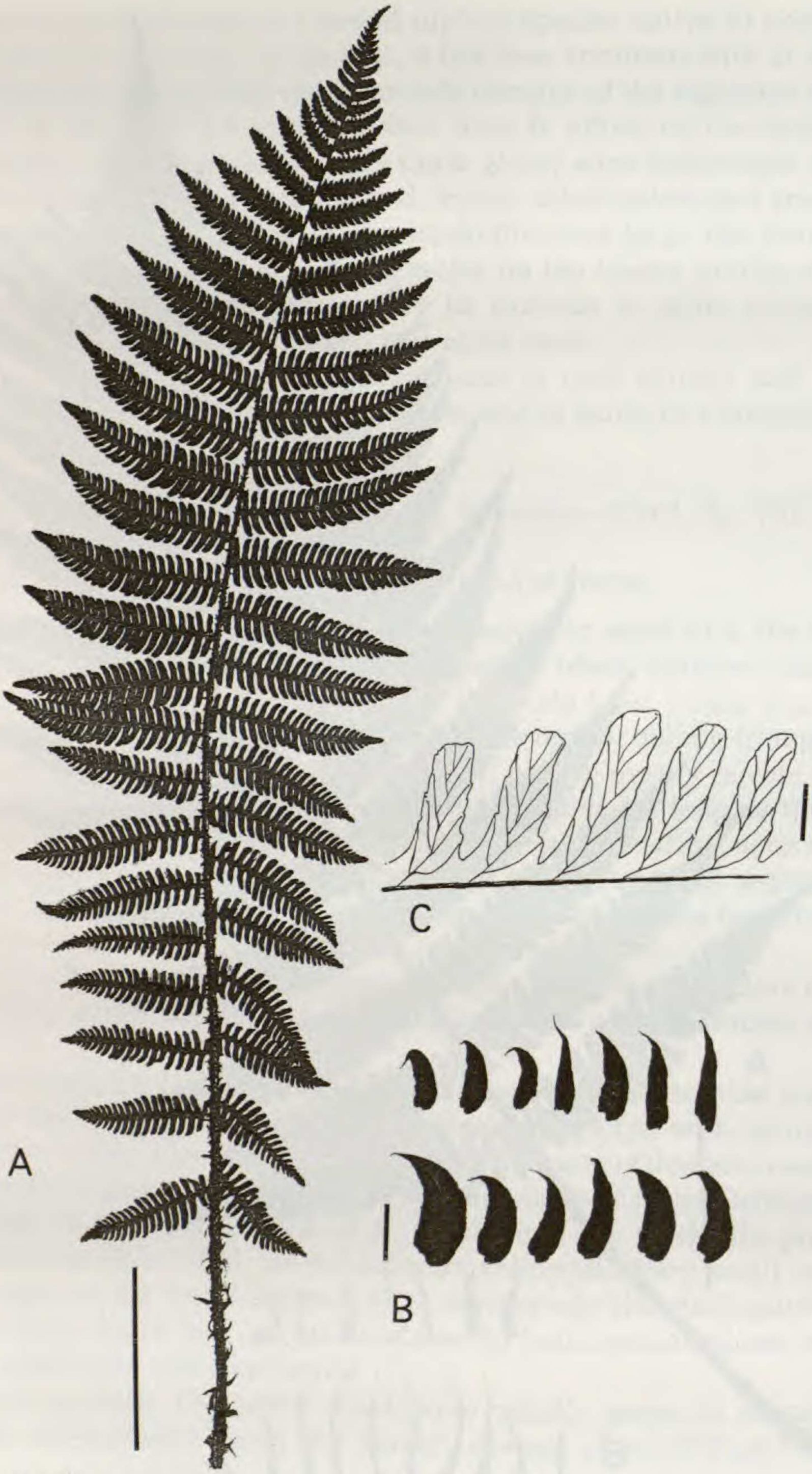


FIG. 9. *Dryopteris polylepis*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Pinnules from medial pinna showing unbranched veins [scale=1cm].

the scale apex, rachis scales many, like the stipe scales but shorter and paler at the base; blade narrowly elliptic to oblanceolate, to ca. 54 cm long, 18 cm wide, pinnate-pinnatifid in distal part to pinnate-pinnatisect in the proximal part, apex acuminate, pinna elongate linear triangular, sessile, proximal pinnae gradually shortened to 4–5 cm, costa scales like the rachis scales and with small pale brown ovate-fimbriate scales; segments narrow, mostly oblong-falcate, many, close, the margins subentire or serrate, the apex rounded to round-truncate, the veins per segment 6–7 pairs, unforked except for those in the basiscopic segments next to the rachis, there the veins often forked. Sori large, marginal, 3–5 per segment, sori in distal ⅓ of the blade; indusia round with shallow sinus, gray-brown at center, thick.

Dryopteris polylepis is a sexual diploid species from northeastern Asia. The unforked veins, except for those in the basiscopic segments next to the rachis, readily identify this species from other cultivated material of this section, as do the narrower, longish pinnules (or segments).

It is hardy to a January average of 35°F; deciduous in southern California.

9. Dryopteris pseudo-filix-mas (Fée) Rothm. (Candollea 10:96. 1945).—Fig. 10.

Rhizome erect, stout, producing offshoots. Fronds fasciculate, erect; stipe short, dense scaly at least at base, the scales membranous, mixed, the larger ones triangular to ovate-lanceolate or ovate, to ca. 15 mm, but usually less, brown, many darker at the base and center; blade linear-triangular to oblanceolate, to 2 pinnate except 2 pinnate-pinnatifid (to 3 pinnate) if the lowest basiscopic pinnule next to the rachis is developed, 40–80 cm long, 14–25 cm wide; pinnae narrow triangular, mostly sessile, proximal pinnae often shorter and broader triangular, the basal ones usually inequilateral, broader on basiscopic side, underside of costa next to rachis with black blotch at least on fresh material; larger costal scales mostly triangular, base and center darker, often abruptly tapered to a long filamentous apex, margins sparsely fimbriate ciliate; the lowest basiscopic pinnule next to the rachis pinnately lobed to pinnatifid (or pinnate), usually with at least 1 more or less rectangular, lobe cut ½ way to midrib of pinnule, often elongate, sessile, less often slightly adnate on distal side, pinnules (or segments) oblong, side margins more or less parallel, subentire, larger ones shallowly serrate, the apex rounded or more or less truncate and toothed, apices of basal segments acute. Sori medial, mostly in distal part of frond; indusia round reniform or some broader and with a wider sinus, opaque, young indusia with margins tucked under sorus lifting and shriveling upon ripening.

Dryopteris pseudo-filix-mas is an apogamous triploid species native to high elevation cloud forests in Mexico and Guatemala. The best distinguishing character of *D. pseudo-filix-mas* is the often elongate basal basiscopic pinnule next to the rachis that is pinnately lobed to pinnatifid (or pinnate?) with the lobes rectangular. However, fronds from younger plants (even 2–3 years old) often do not develop this distinct basiscopic pinnule or do so only weakly, thus making it difficult to separate *D. pseudo-filix-mas* from *D. affinis*, especially

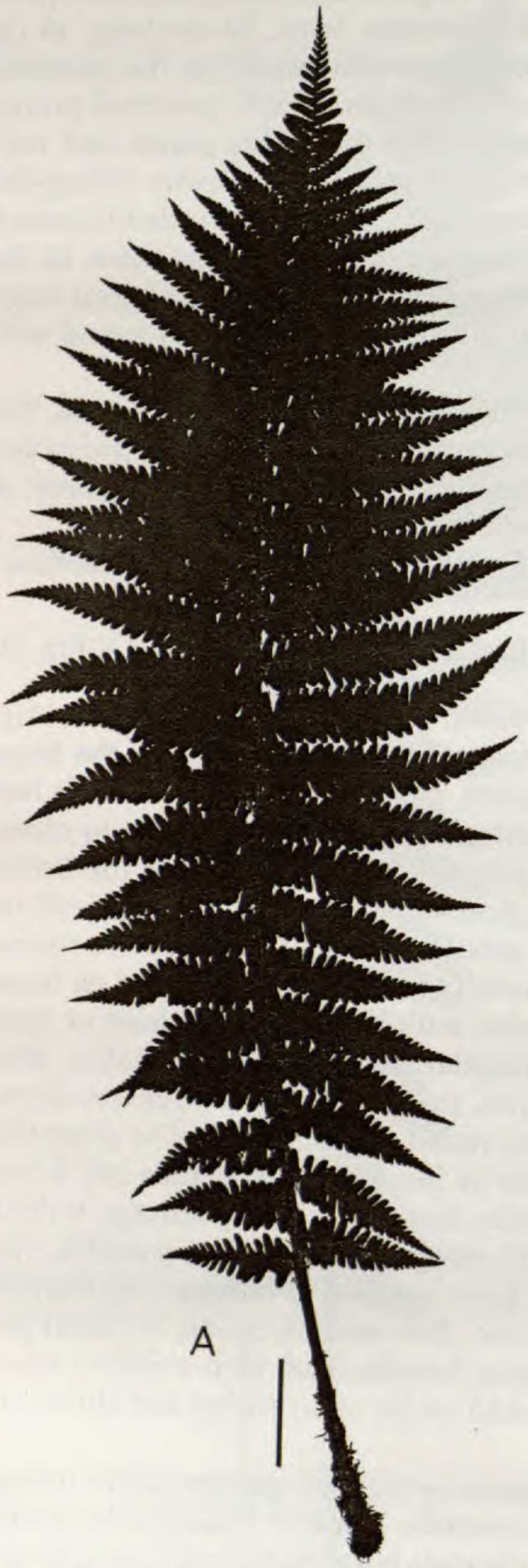


FIG. 10. *Dryopteris pseudo-filix-mas*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Lowest pinnae from different fronds showing the margins of the basal pinnules [scale=1cm].

ssp. *borreri*. *Dryopteris filix-mas* has teeth extending from the pinnule (or segment) apex down the slightly tapered sides, whereas *D. pseudo-filix-mas* has more parallel-sided segments with subentire to weakly serrate margins. John Mickel of the New York Botanical Garden introduced *D. pseudo-filix-mas* into cultivation in the U.S. from Mexico, whereas in Europe it was introduced by Christopher Fraser-Jenkins.

Dryopteris pseudo-filix-mas is hardy to a January average of ca. 30°F. This fern is easy to grow and may produce ample offshoots in late summer. It is semi-deciduous in New York and Seattle, but evergreen in Los Angeles.

10. Dryopteris wallichiana (Spreng.) Hyl. (Bot. Not. 1953:352. 1953).—Fig. 11.
D. paleacea (D. Don) Hand.-Mazz.
D. parallelogramma (Kunze) Alston

Rhizome erect, stout, may produce offshoots. Fronds fasciculate, erect; stipes 8–25 cm long, ¼ or less the frond length, densely covered with scales, the scales narrow triangular to lanceolate, to 25 mm or more long, 3 mm or more wide, black or very dark brown [in cultivated plants and plants from Asia; mid to pale brown in tropical American and Hawaiian plants], apex ending in a long filament; rachis densely scaly with same type of scales except smaller; blade pinnate-pinnatifid except weakly 2-pinnate in proximal part next to rachis, long-ovate to lanceolate, 50–100 cm long, 18–28 cm wide, lustrous dark green above, lighter below and veins conspicuous; pinnae linear-triangular, sessile, base of costa on underside faintly dark or not; segments rectangular, apex truncate or rounded-truncate, margins toothed, subentire to weakly crenate-serrate to serrate, often slightly reflexed. Sori medial; indusia round reniform, entire, convex at maturity, dark brown when dried.

Dryopteris wallichiana apparently exists at various ploidies (most reports are of apogamous diploids, but triploid, tetraploid and other counts have been reported). It is distributed in tropical regions from Mexico to South America, Africa, Himalayan region, China, Japan, and Hawaii. It is found in terrestrial habitats in cloud forests at high elevations. This species is set apart by the very narrow black or very dark brown scales (mid brown in tropical American plants) on the stipe and rachis, the evenly placed rectangular, lustrous segments, and the conspicuous veins on the somewhat lustrous underside of the segments. The segment margins tend to be reflexed.

Dryopteris wallichiana can be a large fern. It is hardy to a January average of 40°F and is semi-deciduous in cool winters. When not receiving sufficient coolness and humidity, the frond and pinnae tips tend to abort.

Section 2.3. Pandae Fraser-Jenk.

Fronds 1–2-pinnate, lanceolate to narrow-lanceolate; stipe with scattered, usually pale lanceolate or ovate-lanceolate scales; blade pale-green, somewhat succulent-herbaceous; pinna lobes or pinnules usually with wide, obtuse or rounded apices.

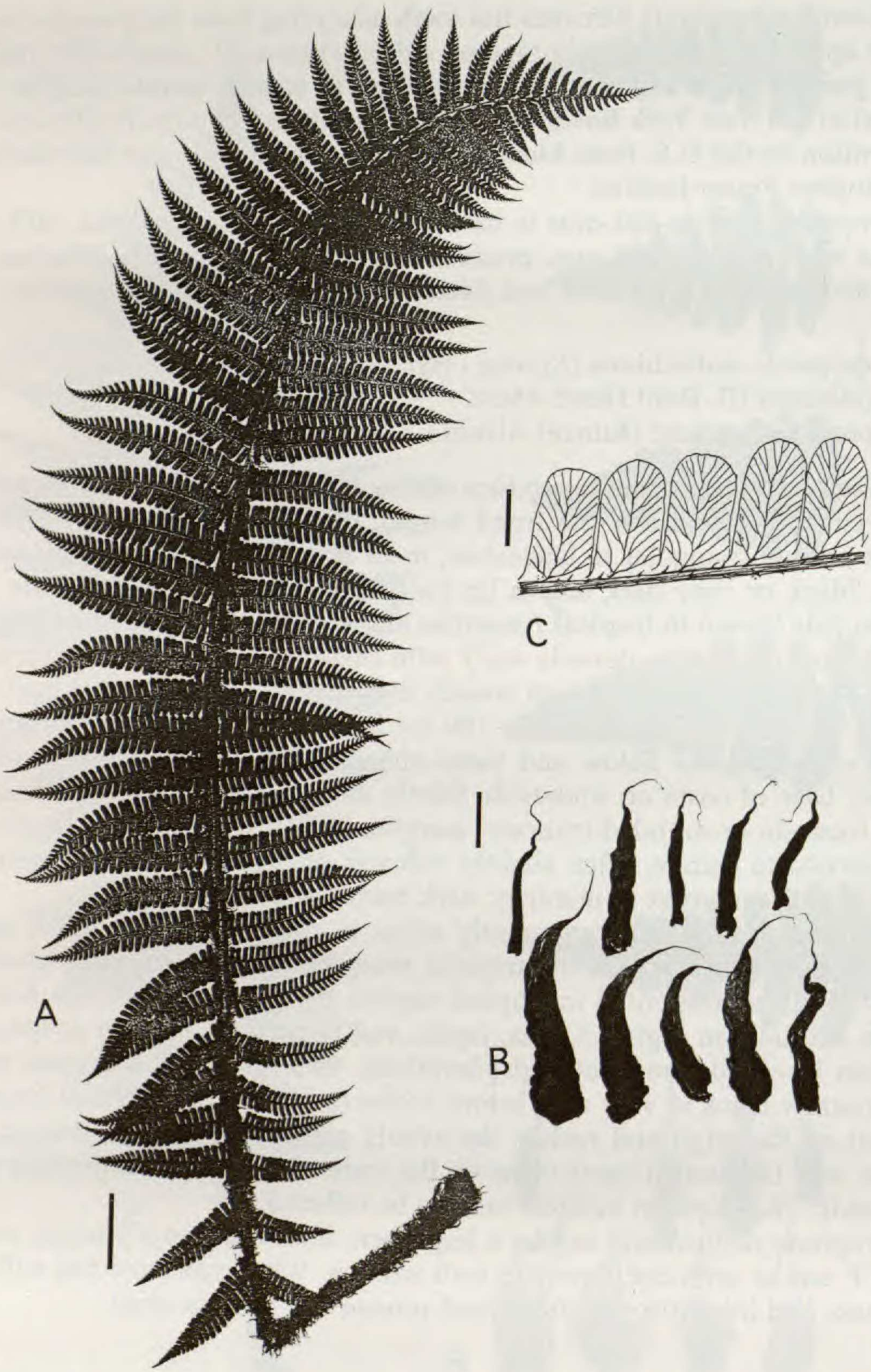


FIG. 11. *Dryopteris wallichiana*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Pinnules from medial pinna [scale=5mm].

KEY TO SPECIES OF SECTION *PANDAE*

1. Pinnae shallowly lobed, cut ca. ⅓ or less deep to pinnae midrib . . . . . 15. *D. tokyoensis*
1. Pinnae deeply pinnately divided, cut ⅔ or more deep to pinnae midrib
   2. Fertile pinnae noticeably narrower than the sterile ones and restricted to the distal ½ of the blade . . . . . 14. *D. ludoviciana*
   2. Fertile and sterile pinnae of approximately the same width
      3. Blade ovate-lanceolate, tapering gradually from below the middle to the tip; basal pinnae ovate-lanceolate; scales dark brown or pale brown with dark center . . . . . 11. *D. celsa*
      3. Blade oblong-lanceolate, tapering in the distal ¼; basal pinnae deltate to elongate-deltate; scales pale brown, with or without a dark brown center
         4. Basal pinnae deltate (as long as or only slightly longer than wide); pinnae of the fertile frond twisted at right angles to the blade surface as in an open Venetian blind . . . . . 13. *D. cristata*
         4. Basal pinnae elongate-deltate (ca. 2 times longer than wide); pinnae of the fertile frond not strongly twisted . . . . . 12. *D. clintoniana*

11. Dryopteris celsa (W. Palmer) Knowlt., W. Palmer & Pollard (Proc. Biol. Soc. Wash. 13:202. 1900).—Log fern.—Fig. 12.

Rhizome short to moderately creeping, branched. Fronds 90–120 cm long, 20–30 cm wide, erect; fertile and sterile fronds and pinnae alike; stipe ½–⅓ the length of the frond, the scales dark brown or pale brown, usually with a dark center; blade pinnate-pinnatifid, ovate-lanceolate tapering gradually from below the middle to the tip; basal pinnae ovate-lanceolate, with their first few basal pinnules the same length as or shorter than the adjacent ones. Sori medial; indusia without glands.

Dryopteris celsa is an uncommon sexual tetraploid species native to the swamps and wet woods of the eastern United States. It is believed to have originated from a cross of *D. goldiana* × *ludoviciana* followed by a doubling of the chromosomes. *Dryopteris celsa* differs from *D. clintoniana* in the blade ovate-lanceolate, the basal pinnae ovate-lanceolate, and the scales dark brown or pale brown with a dark center stripe.

This robust fern is deciduous or semi-deciduous in southern California and is easily cultivated in moist soil. In the wild, it grows in areas where the average January temperature reaches 25°F.

12. Dryopteris clintoniana (D.C. Eaton) Dowell (Proc. Staten Island Assoc. Arts 1:64. 1906).—Clinton's wood fern.—Fig. 13.

Rhizome short creeping, branched. Fronds 40–120 cm long, 15–20 cm wide, fertile fronds longer than the sterile fronds; stipe ⅓ the length of the frond or more, the stipe scales pale brown, at times with a dark brown center; blade herbaceous, pinnate-pinnatifid, broad oblong-lanceolate, tapering to the tip in the distal ¼, basal pinnae elongate-deltate, ca. 2 times longer than wide, widest at the base, the basiscopic segments longer than the acroscopic ones. Sori medial; indusia without glands.

Dryopteris clintoniana is a hexaploid sexual species native to northeastern North America, where it grows in moist woods and swamps. This species is believed to have originated from the cross of *D. cristata* × *goldiana* followed

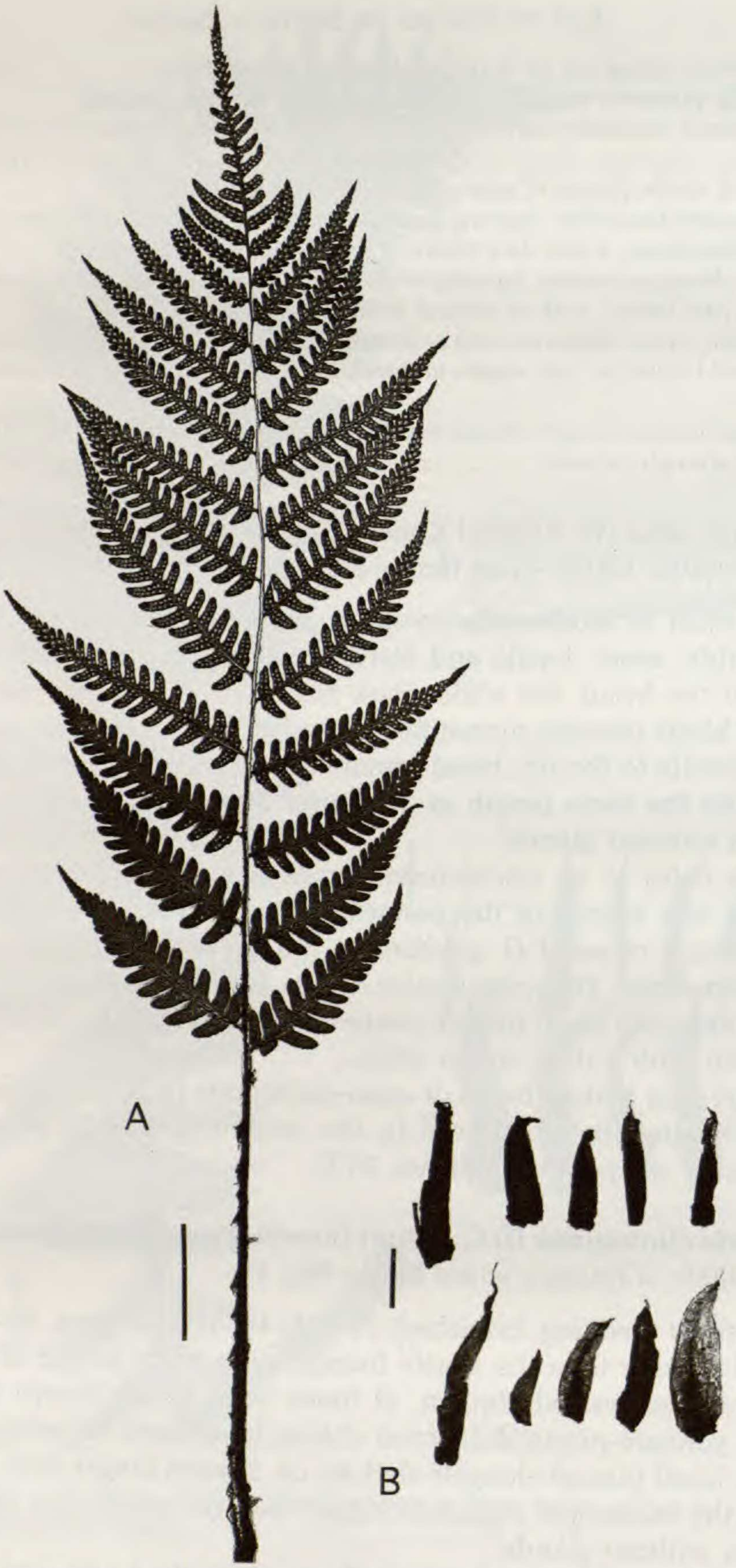


FIG. 12. *Dryopteris celsa*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

FIG. 13. *Dryopteris clintoniana*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

by a subsequent chromosome doubling. Somewhat similar to *D. cristata* in appearance, it differs in having basal pinnae that are distinctly longer than wide and that, in fertile fronds, are not strongly twisted as in an open Venetian blind.

Dryopteris clintoniana is easily cultivated in moist soil in shady gardens. The fertile fronds are deciduous; the sterile fronds, semi-deciduous. In the wild, it grows in areas where the average January temperature reaches 20°F.

13. Dryopteris cristata (L.) A. Gray (Manual, ed. 1, 631. 1848).—Crested wood fern.—Fig. 14.

Rhizome short creeping to erect, may produce offshoots. Fronds 30–75 cm long, 7–12 cm wide, the fertile fronds longer and more erect than the sterile fronds, which are ½–⅓ shorter than the fertile ones; stipe ⅓–¼ the length of the frond, stipe scales light brown; blade herbaceous, pinnate-pinnatifid, narrowly oblong-lanceolate, tapering to the tip in the distal ¼, without glands, fertile and sterile pinnae not markedly different, the fertile pinnae usually twisted at right angle to the blade surface, as in an open Venetian blind; pinnae oblong-triangular widest at the base, basal pinnae not much longer than wide. Sori medial; indusia without glands.

Dryopteris cristata is a sexual tetraploid species from northern and eastern North America and Europe, where it grows in bogs, swamps, and wet woods. This species is believed to have originated from a cross between *D. ludoviciana* and an as yet unknown species followed by a doubling of the chromosomes. The Venetian blind orientation of the pinnae and the deltate basal pinnae help distinguish this species.

Dryopteris cristata is easily cultivated in moist soil, particularly favoring wetter areas, where it grows to its maximum size; fertile fronds deciduous, sterile fronds semi-evergreen. In the wild it grows in areas where the average January temperature reaches 0°F, but surprisingly grows well in southern California, where it barely becomes deciduous.

14. Dryopteris ludoviciana (Kunze) Small (Ferns S.E. States 281. 1938).—Southern wood fern.—Fig. 15.

Rhizome short-creeping to erect, branching to produce offshoots. Fronds erect, 60–120 cm long, 15–30 cm wide; stipe ¼ the length of the frond, stipe scales pale brown; blade pinnate-pinnatifid, elliptic-lanceolate, dark-green, herbaceous, semi-evergreen, without glands; fertile pinnae restricted to distal ½ of the blade and much narrower than the sterile ones, basal pinnae triangular, smaller than those above them. Sori medial, indusia without glands.

Dryopteris ludoviciana is a sexual diploid species native to the southeastern U.S., where it grows in swamps and wet woods. It is easily recognized by its pinnate-pinnatifid blade in which the pinnate fertile pinnae are distinctly narrower than the sterile ones and are restricted to the distal half of the blade.

Dryopteris ludoviciana is easily cultivated in moist, rich garden soil. In the

FIG. 14. *Dryopteris cristata*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

FIG. 15. *Dryopteris ludoviciana*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

wild, it grows in areas where the average January temperature reaches 50°F. It is nearly evergreen in southern California.

15. Dryopteris tokyoensis (Matsum. & Makino) C. Chr. (Index Filicum 298. 1905).—Fig. 16.

Rhizome erect or ascending at times branching and producing offshoots. Fronds erect forming a crown, 35–90 cm long, 11–20 cm wide, fertile and sterile fronds similar, deciduous; stipe ¼–⅕ the length of the frond, the stipe scales light brown; blade pinnate, oblanceolate gradually narrowing to the base; pinnae lobed, mostly cut ¼ or less deep, the basal lobes enlarged to resemble auricles; fertile pinnae narrower than the sterile pinnae and borne on the distal ⅓ of the blade. Sori medial; indusia without glands.

Dryopteris tokyoensis is a sexual diploid from eastern Asia. This popular fern has narrow, erect fronds that form a whorled, crown-like cluster. The shallow lobing of the pinnae distinguishes this species as do the gradual tapering of the blade at the base and the auricle-like lobes at the base of the pinnae.

D. tokyoensis is very easily cultivated in moist acidic soil and is deciduous. It is, however, well liked by slugs which can rapidly destroy small plants. Plants do not do well in southern California, possibly because of the absence of acid soil or a need for winter chilling. It appears to be related to *D. ludoviciana* and may be a partial variant of it (Fraser-Jenkins, pers. com.), although it has been treated as a distinct species. In the wild, it grows in areas where the average January temperature reaches 15°F.

Section 2.4. Dryopteris

Fronds linear-lanceolate to lanceolate (oblong-triangular in *D. goldiana*), 2-pinnate, the pinnules widely attached to the costae except at the bases of the proximal pinnae. Pinnules slightly, but not markedly, parallel-sided, usually somewhat tapering to their apices from ca. ⅔ their length, toothed at the sides and markedly so at the apices, usually with long acute teeth. Blade matte, herbaceous, the scales of stipe and rachis mostly lanceolate or ovate-lanceolate.

Key to Section *Dryopteris*

1. Blade oblong triangular, the basal pinnae ca. equal to or longer than those above . . . . . 19. *D. goldiana*
1. Blades with the basal pinnae shorter than those above
   2. Small ferns, fronds less than 30 cm long . . . . . 18. *D. fragrans*
   2. Medium to larger ferns, fronds more than 30 cm long
      3. Fronds spreading, blade variable, mostly ovate-lanceolate, tip of segment with acute teeth more or less pointing toward the segment apex; indusia thin and white when young, flat or slightly convex
         4. Pinnae widest at their base; indusia convex, white when young, brown when older, margins entire; pinnule toothed around apex, teeth not in pairs . . . . 17. *D. filix-mas*

FIG. 16. *Dryopteris tokyoensis*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

4. Pinnae widest at their middle; indusia flat, white at all stages, margins lacerate; pinnule double toothed all around ..... 16. *D. caucasica*
3. Fronds erect, blade lanceolate, more narrowed at base, tip of segment with obtuse teeth pointing away from the segment apex, indusia thick and green when young, wrapping around the sori
   5. Fronds pale gray-green, to 50 cm long, stipe base scales matte, pinnule teeth spreading out in a fan-like fashion around the apex ..... 20. *D. oreades*
   5. Fronds yellowish-green, to 122 cm long, stipe base scales glossy, pinnule teeth not spreading ..... 21. *D. sichotensis*

16. Dryopteris caucasica (A. Braun) Fraser-Jenk. & Corley (Brit. Fern Gaz. 10: 221–231. 1972).—Fig. 17.

Rhizome usually ascendent at apex, horizontal below, stout, forming offshoots. Fronds to 105 cm, erect, spreading, fasciculate; stipe ¼–½ length of blade, the scales sparse, pale brown, narrowly triangular to ovate-lanceolate, up to ca. 2 cm long, toothed towards the attenuate apex; blade to ca. 80 cm long, 35 cm wide, mostly ovate-lanceolate to elliptic, flat, herbaceous, 2-pinnate; pinnae to 20 cm long, 5 cm wide, lanceolate or frequently narrow long triangular with attenuate apex, pinnatisect to pinnate, the pinnules (or segments) with margins entire to mostly lobed, the lobes with very acute, distinct teeth usually arranged in pairs. Indusia very thin, membranous, white, greatly overlapping the sporangia shortly before maturity, edges lacerate, rapidly shrivelling.

Dryopteris caucasica is a diploid sexual species native to forests in the alpine regions of the Middle East (200–850 m elev.). It was introduced into U.S. cultivation very recently, probably from horticultural sources in Britain originating from Fraser-Jenkins' collections. *Dryopteris caucasica* is one of the parent species of *D. filix-mas* and is best distinguished from it by the generally paler color of the lamina, the doubly-toothed margins of the segments, and the indusia, which are white at all stages (until shrivelling) and have lacerate margins. The distinct acuteness of the usually paired teeth at the apex of the pinnules (or segments) and their lobes, and the flatness, thinness and lacerate margin of the indusia are important characters of this fern. In case of doubt, its very dark spores distinguish it from *D. filix-mas*. Wild plants apparently do not form side crowns as readily as those in cultivation.

Dryopteris caucasica is easily cultivated, and is deciduous at first frost. It is hardy to at least 30°F and perhaps to 20° F, but doesn't tolerate summer drought as well as *D. filix-mas*.

17. Dryopteris filix-mas (L.) Schott (Gen. Fil., plate 9. 1834).—Common male fern.—Fig. 18.

Lastrea filix-mas (L.) C. Presl

Rhizomes erect, stout, producing offshoots. Frond 35–150 cm long, 5–30 cm wide; stipe ¼–½ the length of the blade, sparsely to moderately scaly, the scales mixed, larger ones mostly narrow ovate to broad ovate, to ca. 14 mm long, 6 mm wide, margins erose, sparsely and irregularly fimbriate and toothed, mem-

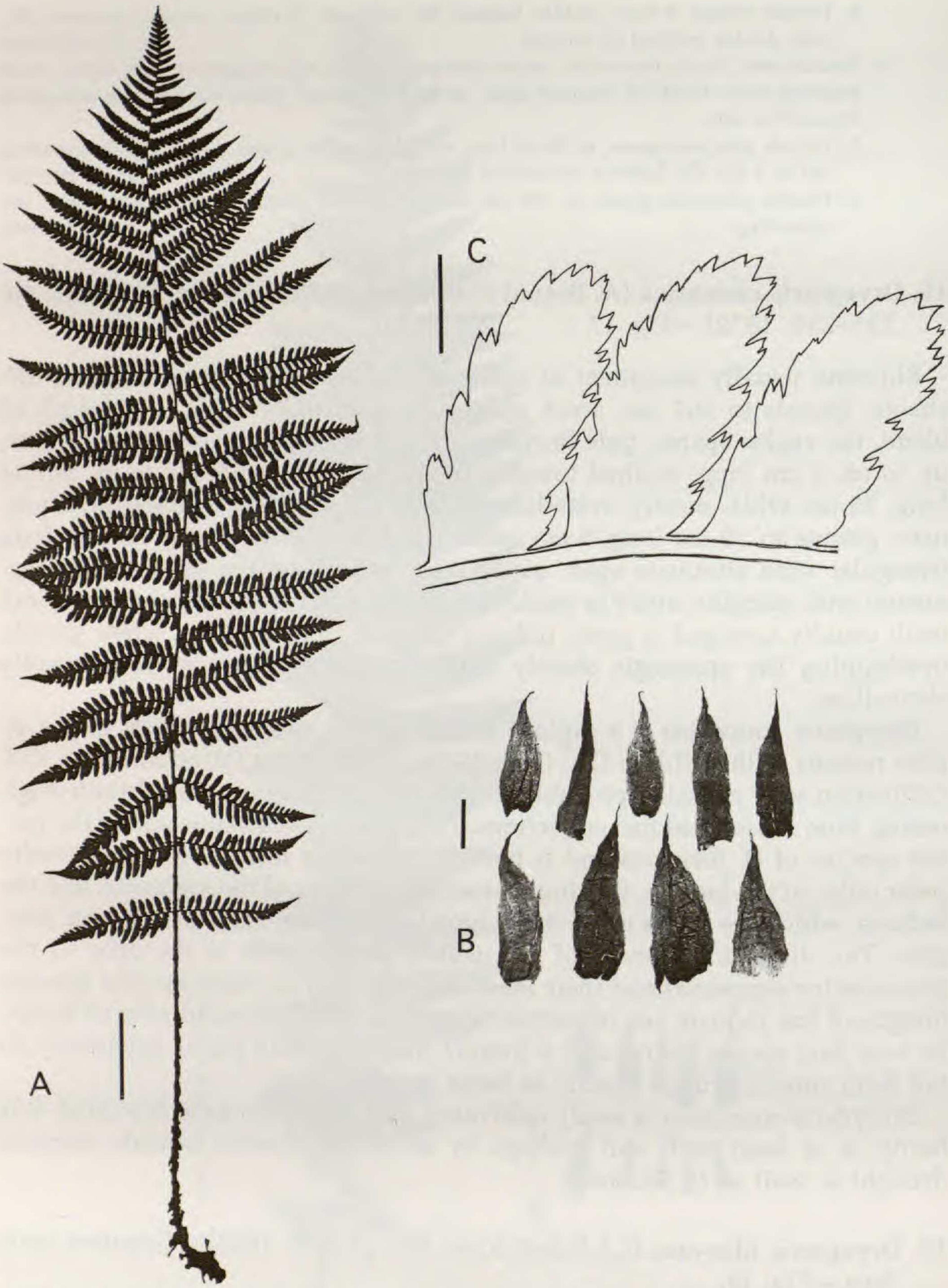


FIG. 17. *Dryopteris caucasica*. A) Frond [scale=5cm] after Fraser-Jenkins & Corley (1972). B) Stipe scales [scale=5mm]. C) Pinnules (segments) from medial pinna [scale=5mm].

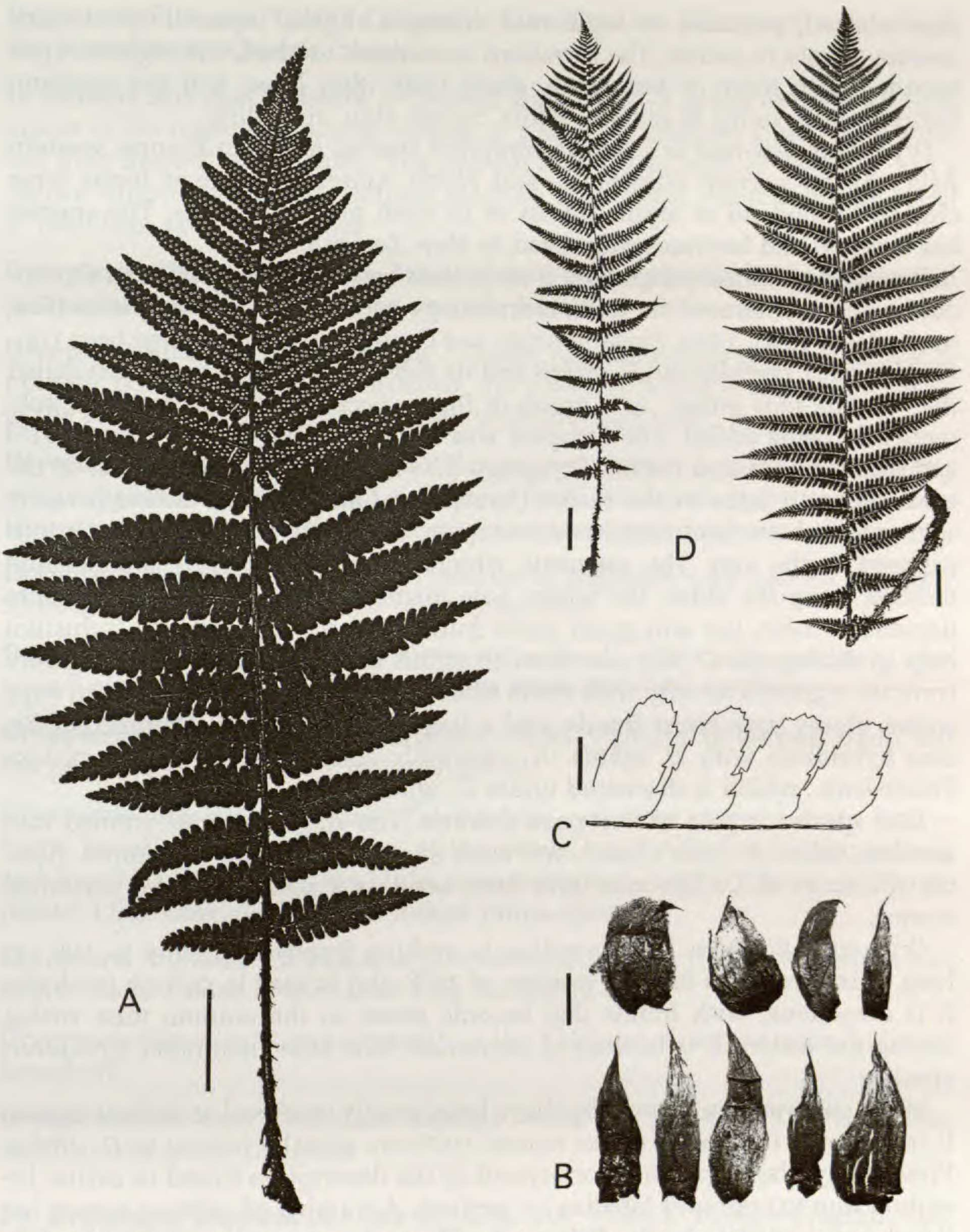


FIG. 18. *Dryopteris filix-mas.* A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Pinnules (segments) from medial pinna [scale=5mm] D) Other frond variations [scale=5cm].

branous, pale brown, rachis scales same as the stipe scales except smaller, narrower and more triangular; blades pinnate-pinnatifid to 2-pinnate at the base next to the rachis, oblong to obovate-lanceolate, usually narrowed to a truncate base, more or less herbaceous, green, slightly paler beneath; pinnae

short stalked; pinnules (or segments) oblong to slightly tapered, the margins crenate-serrate to serrate, the serrations sometimes toothed, the segment apex rounded with more or less acute, sharp teeth. Sori large, 4–6 per segment; indusia when young to mature, white, round, thin, spreading.

Dryopteris filix-mas is a sexual tetraploid species native to Europe, western Asia, the far-western Himalayas, and North America, where it forms large clumps in lowland or alpine forests or in open places on rocks. The species has escaped and become naturalized in New Zealand.

Dryopteris filix-mas originated from a cross between *D. oreades* and *D. caucasica* and is intermediate in its morphology between these two species (Fraser-Jenkins, 1976, 1989; Fraser-Jenkins and Corley, 1972). It has long been confused with *D. oreades* and *D. affinis* and its subspecies, which have been called the "*D. filix-mas* group" as a group of three species, with *D. caucasica* subsequently being added. The complex was sorted out first by Wollaston (1915) and finally by Manton (1950). *Dryopteris filix-mas* lacks the dark blotch on the costa where it joins to the rachis (Jermy and Camus 1991), although rarely some plants have faint dark streaks or spots, especially on old leathery fronds exposed to the sun. The segments which are usually slightly tapered and toothed along the sides, the wider, pale membranous stipe scales, the more deciduous habit, the mid-green matte fronds and the less inflexed indusium help to distinguish *D. filix-mas* from *D. affinis* which has parallel-sided, more truncate segments usually with entire side margins, narrow golden-brown stipe scales, glossy dark green fronds, and a less deciduous habit. *Dryopteris filix-mas* hybridizes with *D. affinis*. A commonly sold hybrid is *D.* ×*complexa* Fraser-Jenk., which is discussed under *D. affinis*.

This species is part of European folklore. The rhizomes were formed into amulets, called St. John's hand, and worn as protection from evil spirits. Also, the rhizomes of *D. filix-mas* have been used as a medication for intestinal worms.

Dryopteris filix-mas has spreading to arching fronds that grow to 100 cm long. It is hardy to a January average of 20°F, and is easy to culture in shade. It is deciduous, with fronds that become prone in the autumn then wither during the winter. It is tolerant of somewhat drier sites than other *Dryopteris* species.

Many cultivars are known, but have been greatly confused as to their names. It is probable that many of the named cultivars actually belong to *D. affinis*. Present-day plants may not correspond to the description found in earlier literature due to confused labeling in gardens. A number of cultivar names not listed here circulate in the U.S. trade. The more common ones in the U.S. trade are:

Dryopteris filix-mas 'Barnesii'.—Barnes' male fern.—Growth upright, narrow fronds, ca. 130 cm long, 10 cm wide, the pinnae short, wide, the pinnules narrowed at the base, oval, deeply lobed, the lobes often serrate or toothed, frequently double toothed. Matches earlier material by same name (Druery, 1910).

Dryopteris filix-mas 'Crispa Cristata'.—Like 'Cristata' of current trade, except the pinnules or segments crisped.

Dryopteris filix-mas 'Cristata'.—Crested male fern.—A group of cultivars with apices of the blade and pinnae ending in a small to medium sized tassel without long finger-like divisions. The current trade plant sold as 'Cristata' has a narrow elliptic blade and compact medium size tassels, sometimes the tassel at the blade apex quite large.

Dryopteris filix-mas 'Cristata Martindale'.—Wide elliptic blade, blade and pinnae with small crest, pinnae strongly falcate.

Dryopteris filix-mas 'Decomposita'.—Large, broad, foliaceous frond, almost 2-pinnate, 60–80 cm long, fine textured, the pinnules failing to develop properly at the sides so thickened and incised with irregular teeth.

Dryopteris filix-mas 'Grandiceps'.—Large crested male-fern.—Fronds slightly arching, rachis branching some distance from the fronds apex to form very large crests, pinnae narrow and trimly crested, vigorous grower.

Dryopteris filix-mas 'Linearis'.—Pinnules or segments very narrow to nearly filiform. Originated from spore of 'Decomposita'.

Dryopteris filix-mas 'Linearis Congesta'.—Small plant with modestly narrowed pinnules or segments, the pinnae short and close together.

Dryopteris filix-mas 'Linearis Cristata'.—Like 'Cristata' of current trade, but the pinnules or segments greatly narrowed.

Dryopteris filix-mas 'Linearis Polydactyla'.—Slender crested male fern.—Blade broadly elliptic, divisions of the tassels on the blade and pinnae long and finger-like, the segments of the pinnae linear to nearly filiform or depauperate. Like 'Linearis' but with forked pinna apex.

Dryopteris filix-mas 'Polydactyla'.—With tassels on the tips of the pinnae and blade, the divisions of the tassel long and finger-like.

Dryopteris filix-mas 'Ramo-cristata'.—Like 'Cristata' of current trade, but stipe branched.

Dryopteris filix-mas 'Undulata Robusta'.—See discussion of *D.* ×*complexa* under treatment of *D. affinis*.

18. Dryopteris fragrans (L.) Schott (Gen. Fil., plate.9. 1834).—Fragrant cliff fern, fragrant wood fern.—Fig. 19.

Rhizome erect, short and thick. Stipe 2–11 cm long, to ⅓ the blade length, tufted, glandular and scaly, the scales broad lanceolate, ca. 3.5 mm long, 1.2 mm wide, thin, irregularly toothed, pale reddish brown, more or less shiny; blade mostly deeply pinnate-pinnatifid, on larger fronds to 2 pinnate-pinnatifid, elliptic or narrowly lanceolate, acutely tapered at both ends, to ca. 6–25 cm long, 2–5 cm wide, covered with yellowish round glands, particularly on

FIG. 19. *Dryopteris fragrans*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

underside; pinnae often overlapping and inrolled, dense scaly; indusia large, whitish, often overlapping, becoming brown, with ragged margins.

Dryopteris fragrans is a sexual diploid fern of circumboreal distribution growing in crevices and on rocks that are often calcareous. In the eastern part of its range (eastern Siberia), the larger, more lax plants with distant pinnae are sometimes recognized as var. *remotiuscula* Kom.; however, most botanists do not recognize this variety, because the variation is reportedly clinal and possibly due to a longer growing season.

Dryopteris fragrans is a small fern suitable for alpine rock gardens. It is hardy to a January average of −20°F.

19. Dryopteris goldiana (Hook. ex Goldie) A. Gray (Manual, ed. 1, 631. 1848).—Goldie's wood-fern, Goldie's fern.—Fig. 20.

Rhizome ascending-erect, stout. Stipe slightly shorter than the blade, 15–45 cm long, scaly, the scales mostly narrow to broad lanceolate, thin, pale brown, those at the stipe base with a dark reddish-brown central strip; blade pinnate-pinnatifid to nearly 2-pinnate, triangular or to widely ovate, 30–130 cm long, 20–45 cm wide, base obtuse or truncate, apex abruptly narrowed to an acuminate tip; pinnae oblong-lanceolate, basal ones narrowed at their base, stalked, apex attenuate pinnatifid-serrate, the lowest pinnae equal or nearly equal to those above; pinnules (or segments) long oblong, serrate. Sori close to the midrib; indusia red-brown when dry.

Dryopteris goldiana is a sexual diploid species from central and eastern North America. It is frequent in damp woods and on stream banks, often among rocks.

It is a coarse fern, which prefers moist soil, and full shade to partial sun. When young, the fronds have a yellow tinge. It is semi-deciduous and hardy to a January average of 20°F.

Dryopteris goldiana has formed hybrids with several other species of *Dryopteris,* one of which, *D. clintoniana* (D.C. Eaton) Dowell (*D. cristata* × *goldiana*), is cultivated.

20. Dryopteris oreades Fomin (Věstn. Tiflissk. Bot. Sada 18:20. 1910).—Mountain male fern, dwarf male fern.—Fig. 21.

Lastrea propinqua Wollaston ex Lowe

D. abbreviata (DC.) Newman, misapplied

Rhizome erect, stout, producing offshoots. Fronds stiff, erect, to ca. 70 cm long, 15 cm wide, stipe generally ca. ¼ or less the frond length, the stipe scales moderately dense, mostly narrow to broad lanceolate, membranous, tannish; blade pale gray-green, the margins crisped; blade mostly deeply pinnate-pinnatifid, to 2-pinnate at the base, mostly ovate-lanceolate, 30–50 cm long, undersurface sparsely covered with minute glands, fertile pinnae restricted to distal ⅓ of the blade; pinnae slightly stalked, proximal pinnae triangular; pinnule (or segment) apex rounded with blunt divergent teeth often curving upwards from plane of frond. Indusia more or less thick, granular.

FIG. 20. *Dryopteris goldiana*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

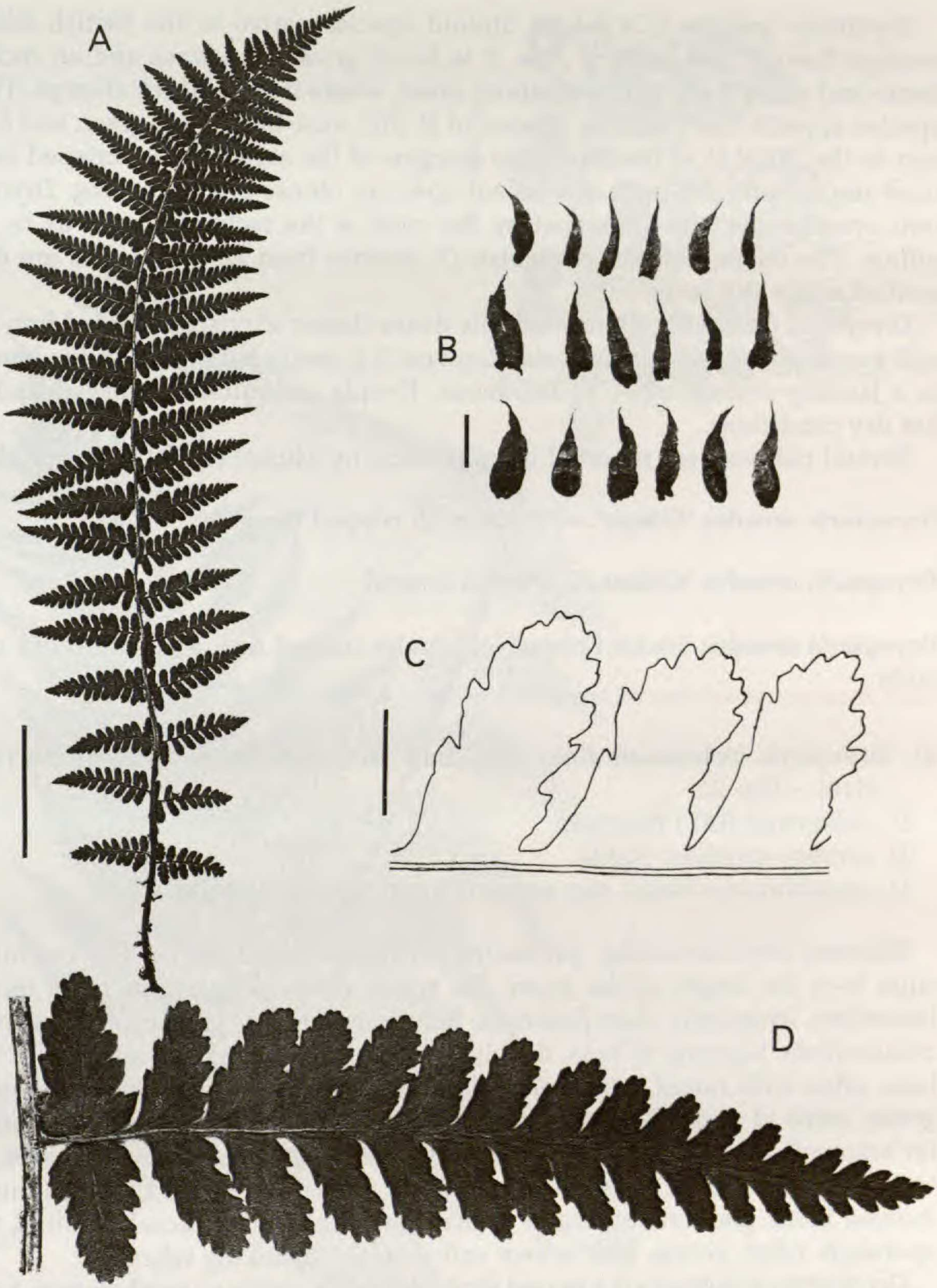


FIG. 21. *Dryopteris oreades*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Pinnules [scale=5mm], D) Medial pinna from a larger frond [scale=1cm].

Dryopteris oreades is a sexual diploid species native to the British Isles, western Europe, and western Asia. It is found growing in scree and on rocky banks and stone walls in mountainous areas, where it forms thick clumps. The species appears like a smaller version of *D. filix-mas*, but is gray-green and has sori in the distal ⅓ of the frond; the margins of the segments are crisped and most importantly the teeth at segment apex are obtuse and spreading. *Dryopteris oreades* lacks the dark spot on the costa at the rachis junction as in *D. affinis*. The characters that distiguish *D. oreades* from *D. sichotensis* are described under the latter.

Dryopteris oreades is attractive for its dense cluster of crisp-margined fronds, and young plants quickly form side crowns. It is easily cultivated and is hardy to a January average of 30°F, deciduous. Fronds are quickly damaged under hot dry conditions.

Several cultivars are reported in cultivation by Mickel (1994) and include:

Dryopteris oreades 'Crispa'.—Pinnae with crisped margins.

Dryopteris oreades 'Cristata'.—Pinnae crested.

Dryopteris oreades 'Incisa Crispa'.—Pinnules incised and crisped, up to 1 cm wide.

21. Dryopteris sichotensis Kom. (Izv. Imp. Bot. Sada Petra Velikago 16:146. 1916).—Fig. 22.

D. abbreviata (DC.) Newman

D. coreano-montana Nakai

D. crassirhizoma Nakai var. *setosa* (Christ) Miyabe & Kudô

Rhizome erect-ascending, producing offshoots. Fronds to ca. 125 cm long; stipe ¼–½ the length of the frond, the scales dense at the stipe base, broad lanceolate, irregularly short fimbriate, light-brown to tan, glossy; blade narrow oblanceolate, tapering to base, deeply 2-pinnate-pinnatifid to 2-pinnate at the base, often with round yellow glands, more or less coriaceous and yellowish-green; veins of underside with few, narrow fibrillose, twisted scales; pinnule (or segment) side margins with more or less rectangular lobes, with few or no teeth, the apex obtuse or rounded with blunt teeth. Sori few to 11 per pinnule; indusia thick, glandular, margins entire, green and fitting closely around the sporangia when young, gray brown and scarcely shrinking when old.

Dryopteris sichotensis is a sexual diploid species native to northeastern Asia, where it is found in open scree and on banks in alpine regions. Its upright habit resembles that of a large *D. oreades*; however, it differs in having more or less glossy stipe base scales, yellow-green fronds, more acute pinnule apices, and slightly less obtuse teeth.

Dryopteris sichotensis is semi-deciduous and hardy to a January average of 10–20°F. It is eaten by slugs.

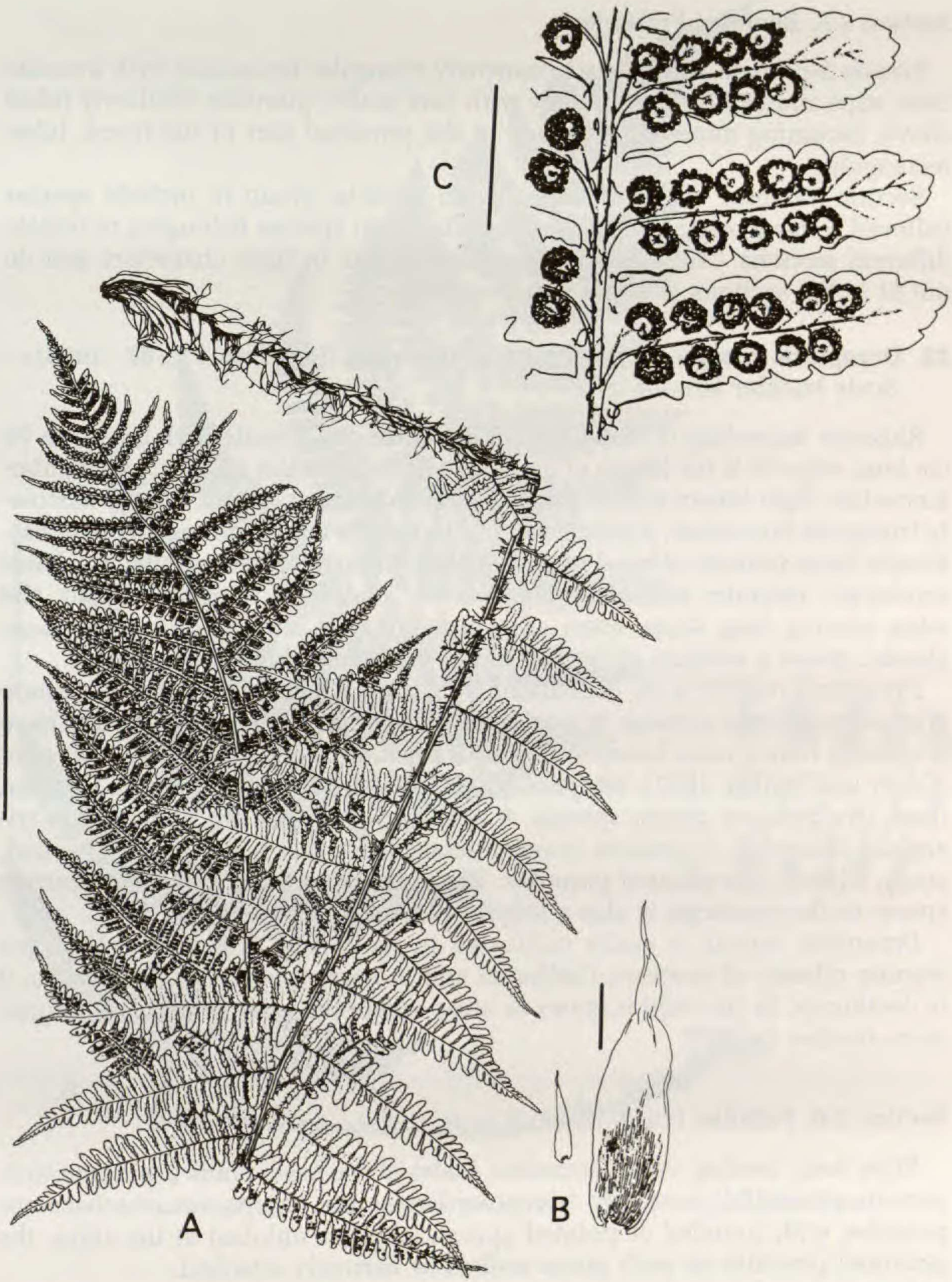


FIG. 22. *Dryopteris sichotensis*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Pinnules [scale=5 mm]. Adapted with permission from Kurata and Nakaike (1979: 435, as *D. coreano-montana*.

Section 2.5. Remotae Fraser-Jenk.

Fronds 2-pinnate, lanceolate to narrowly triangular-lanceolate with truncate base; stipe and rachis densely scaly with dark scales; pinnules shallowly lobed above, becoming more deeply lobed in the proximal part of the frond, lobes rectangular.

Section *Remotae* was established as an artificial group to include species believed to have originated from crosses between species belonging to widely different sections. These hybrids are intermediate in their characters and do not fit in the sections of either parent species.

22. Dryopteris remota (A. Braun ex Döll) Druce (List Brit. Pl., 87. 1908).—Scaly buckler fern.—Fig. 23.

Rhizome ascending to erect, producing offshoots. Fronds dark green, to 75 cm long; stipe ¼–½ the length of the blade, the stipe scales narrowly triangular-lanceolate, light brown with a dark base; blade without glands, mostly narrowly triangular-lanceolate, 2-pinnate-pinnatifid at the base, 2-pinnate above, basiscopic basal pinnule of basal pinnae slightly or distinctly longer that the basal acroscopic pinnule; pinnules oblong-ovate, shallowly pinnately lobed, the lobes bearing long acute, often aristate teeth. Sori medial; indusia without glands; spores a mixture of "good" spores and some abortive spores.

Dryopteris remota is an uncommon subalpine species from Europe, where it grows near forest streams. It is an apomictic triploid species believed to have originated from a cross between *D. affinis* ssp. *affinis* and probably *D. expansa* (Gibby and Walker, 1977). Morphologically, *D. remota* is intermediate between these two putative parent species. It may be recognized by its narrowly triangular-lanceolate, 2-pinnate, nonglandular blades that have shallowly lobed, acute, slightly hair-pointed pinnules. The presence of both good and abortive spores in the sporangia is also a helpful diagnostic character.

Dryopteris remota is easily cultivated in moist soil. It grows well in the warmer climate of southern California and is nearly evergreen. Elsewhere, it is deciduous. In the wild it grows in areas where the average January temperature reaches ca. 30°F.

Section 2.6. Pallidae Fraser-Jenk.

Stipe long, bearing ovate-lanceolate scales at the base; blade 2-pinnate to 2-pinnate-pinnatifid, narrowly triangular-lanceolate, crispaceous-herbaceous; pinnules with rounded or pointed apices, lobed or unlobed at the sides, the proximal pinnules on each pinna stalked or narrowly attached.

KEY TO SECTION *PALLIDAE*

1. Blades densely glandular on both surfaces . . . . . 27. *D. mindshelkensis*
1. Blades without glands or only sparsely glandular
   2. Sori borne only on the distal portion of the blade

FIG. 23. *Dryopteris remota*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

3. Fertile pinnae markedly narrower than the sterile pinnae; stipe scales pale . . . . . 25. *D. lacera*
3. Fertile pinnae similar in shape to the sterile pinnae, not markedly narrowed; stipe scales dark . . . . . 30. *D. uniformis*

2. Sori borne on both the distal and proximal portions of the blade
4. Sori marginal or nearly so; pinnule margins not toothed . . . . . 26. *D. marginalis*
4. Sori medial or near the midvein; pinnule margins toothed
5. Stipe scales pale to dark brown; basal pinnae pinnate-pinnatifid to 2-pinnate, ultimate segment lobes with spreading spine-like teeth . . . . . 23. *D. arguta*
5. Stipe scales brown to very dark brown; basal pinnae 2-pinnate to 2-pinnate-pinnatifid, segments variously toothed
6. Stipe scales regularly minutely toothed or fimbriate; pinnules oblong with parallel sides, the apex rounded to truncate, bearing short acute teeth . . 29. *D. sublacera*
6. Stipe scales not toothed nor fimbriate (sometimes with only a few scattered teeth); pinnules elongate-triangular or oblong with more or less parallel sides, the apex variable
7. Pinnules triangular-lanceolate, deeply lobed, the tips acute . . . 28. *D. stewartii*
7. Pinnules elongate-ovate, hardly lobed, the tips rounded to truncate . . . . . 24. *D. juxtaposita*

23. Dryopteris arguta (Kaulf.) Maxon (Amer. Fern J. 11:3. 1921).—Coastal wood fern, coastal wood fern.—Fig. 24.

Rhizome short-creeping to ascending. Frond 30–80 cm long, 10–20 cm wide, evergreen; stipe ca. ⅓ the length of the frond, the stipe scales mostly ovate, pale brown, rarely with a darkened base; blade yellow-green to green, ovate-lanceolate to triangular, pinnate-pinnatifid to 2-pinnate, leathery, the basiscopic pinnules of the basal pinnae the same length as the acroscopic ones; pinna linear-triangular, the segments oblong-lanceolate, gradually tapering to a rounded-obtuse tip, mostly broadly attached, at times constricted at the base especially in the proximal pinnae, the margins serrate or shallowly lobed and often with fine, spreading, spine-tipped teeth. Sori medial.

Dryopteris arguta is a sexual diploid species found in open woods in western North America. It is characterized by its ovate-lanceolate, mostly pinnate-pinnatifid blade, basal pinnae with their basal basiscopic and acroscopic pinnules of more or less equal length, and segments with serrate margins bearing arching, spine-tipped teeth in which the veins extend into the teeth.

In southern California gardens in summers, this species tends to be deciduous, even when kept moist; however, it is evergreen in areas with cooler summers. It is sometimes difficult to grow. Avoid overwatering during periods of dormancy. In the wild it grows in areas where the average January temperature reaches ca. 45°F.

24. Dryopteris juxtaposita Christ (Bull. Acad. Int. Géogr. Bot. 17:138. 1907).—Fig. 25.

Rhizome erect or ascending. Frond 40–100 cm long, 15–40 cm wide; stipe base scales ovate-lanceolate to narrow-lanceolate, brown to blackish-brown, the upper stipe and rachis with few scattered scales or naked; blade herbaceous, elongate-triangular, pinnate-pinnatifid to 2-pinnate; pinnae elongate-tri-

FIG. 24. *Dryopteris arguta*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

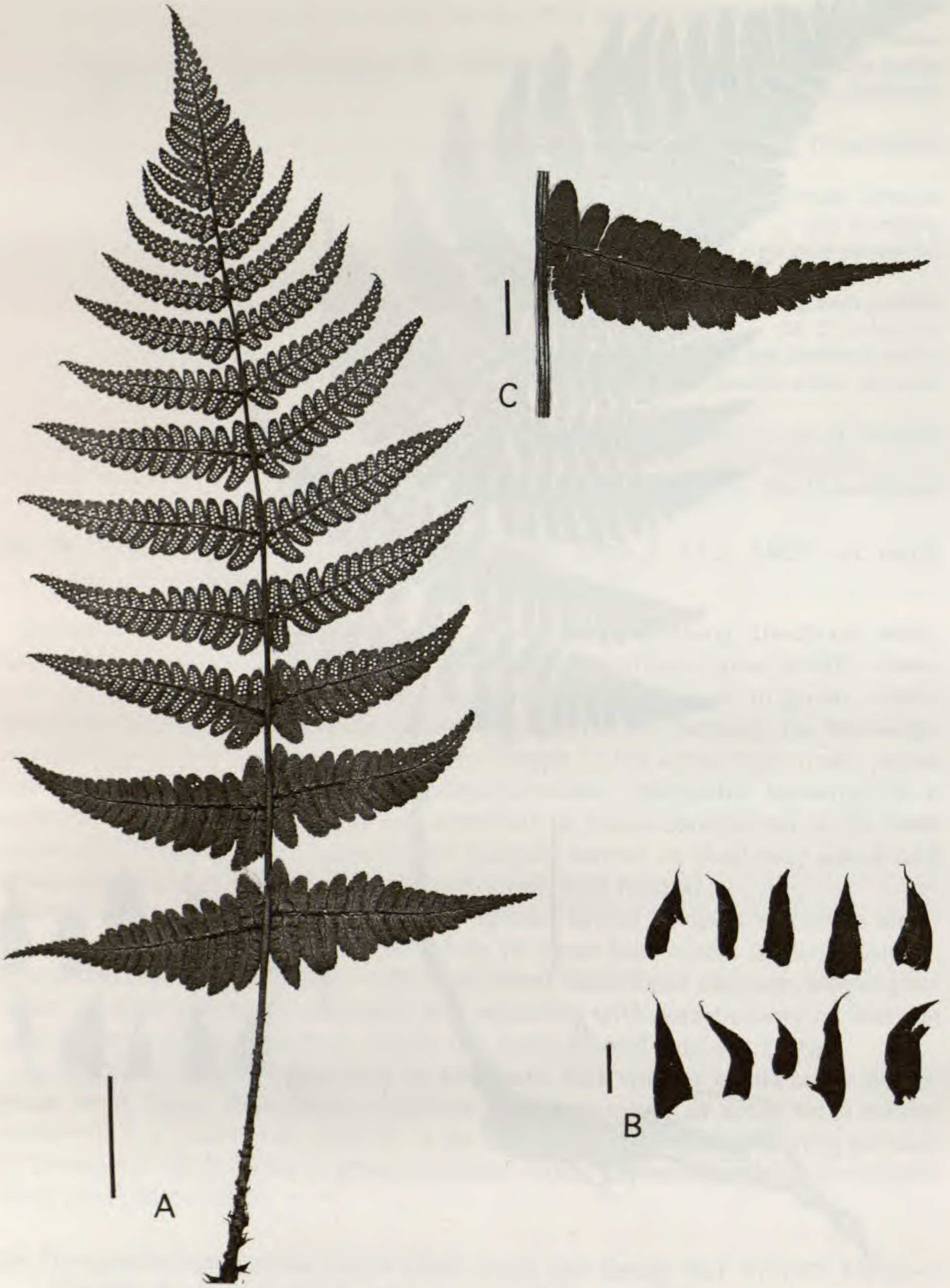


FIG. 25. *Dryopteris juxtaposita*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Basal pinna [scale=1cm].

angular, usually distant; basal pinnules stalked or narrowly attached, with a more or less truncate base, basal basiscopic pinnules somewhat longer than the acroscopic ones, pinnules (or segments) oblong with sides more or less parallel or tapering slightly toward the truncate or somewhat rounded apex and bearing triangular, acute teeth, the pinnules (or segments) mostly with rectangular, shallow lobes, the lobes with truncate apices. Sori medial, distributed throughout the blade; indusium deciduous. Spores irregular.

Dryopteris juxtaposita is an apomictic triploid species from the Himalayan region and extends into southeastern Asia and southern India, where it grows on steep rocky banks. The leaves are deciduous. In the wild, it grows in areas where the average January temperature reaches ca. 50°F.

25. Dryopteris lacera (Thunb.) Kuntze (Rev. Gen. Pl. 2:813. 1891).—Fig. 26.

Rhizome erect or ascending. Fronds 25–75 cm long, 15–25 cm wide; stipe ⅓–¼ the length of the blade, densely covered with pale to reddish brown, shiny, linear-lanceolate to ovate-lanceolate scales; blade broadly lanceolate, pinnate-pinnatifid to 2-pinnate; basal pinnae equal in length or slightly shorter than the ones above, pinnate at their base, pinnatifid above, the pinnules broadly lanceolate to narrowly triangular with a pair of enlarged lobes at their base, stalked, acuminate, the rachis covered with narrow scales; fertile pinnae restricted to the distal ¼–⅓ of the blade, markedly narrower than the sterile ones, withering and drying after shedding spores. Sori medial.

Dryopteris lacera is a sexual diploid species from eastern Asia where it grows along streams and in moist woods. Characteristic of the fern are the broadly lanceolate blade and the constricted fertile pinnae restricted to the distal portion of the blade, which wither and tend to fall off after the spores are shed.

Dryopteris lacera is slow-growing but easily cultivated in moist soil. The fronds lie flat on the ground in winter in southern California. In the wild, it grows in areas where the average January temperature reaches 25°F.

26. Dryopteris marginalis (L.) A. Gray (Manual, ed. 1, 632. 1848).—Marginal wood fern.—Fig. 27.

Rhizome erect or ascending. Frond 40–60 cm long, 15–25 cm wide; stipe ⅓–¼ the length of the frond; stipe scales dense, pale to light brown; blade bluish-green, lanceolate to triangular, pinnate-pinnatifid to 2-pinnate, leathery; evergreen pinnules (or segments) oblong, obtuse, the basal ones contracted at their base, the margins usually entire or at times crenate to pinnately lobed. Sori marginal or nearly so.

Dryopteris marginalis is a sexual diploid species native to northeastern North America, where it is common on wooded rocky slopes and ledges. The fronds are borne in a crown-like cluster. The leathery blades with sori borne near the margins help distinguish this species.

Dryopteris marginalis is easily cultivated in moist soil in temperate regions; it is difficult to grow in southern California. Avoid overwatering during periods

FIG. 26. *Dryopteris lacera*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

FIG. 27. *Dryopteris marginalis*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Medial pinna [scale=5mm].

of dormancy. Its fronds are sometimes deciduous in cultivation, but are evergreen or nearly so in nature. In the wild, it grows in areas where the average January temperature reaches 20°F.

27. Dryopteris mindshelkensis Pavlov (Vestn. Akad. Nauk Kaz. SSR. 8(113): 129, fig. 31. 1954).—Rigid buckler fern, limestone wood-fern.—Fig. 28.
D. submontana (Fraser-Jenk. & Jermy) Fraser-Jenk.
D. villarii (Bell.) Woyn. ex Schinz & Thell. ssp. *submontana* Fraser-Jenk. & Jermy
Lastrea rigida (Sw.) C. Presl, misapplied

Rhizome ascending. Fronds 20–60 cm long, 15–18 cm wide; stipe ½ to as long as the blade, dull pale brown, enlarged at base, the scales dense, glossy, ovate, pale, glandular; blade triangular-lanceolate, widest at the base, 2-pinnate, dull gray-green and densely covered with stalked yellow glands on both surfaces; pinnules widely spaced with acute marginal teeth (not spine tipped); basal pinnules stalked becoming increasingly more broadly attached toward the tips of the pinnae, the basiscopic and acroscopic basal pinnules mostly of equal length. Sori medial, large; indusia glandular.

Recently Fraser-Jenkins (1996) determined *D. submontana* to be conspecific with *D. mindshelkensis* and therefore it must be known by the earlier name. *Dryopteris mindshelkensis* is a sexual tetraploid species from Europe and northern Africa, where it is found growing primarily in crevices on limestone. It is believed to have originated from a cross between *D. pallida* (Bory) C. Chr. ex Maire & Petitm. ssp. *pallida* and *D. villarii* (Bell.) Woyn. ex Schinz & Thell. followed by a doubling of the chromosomes. It is morphologically intermediate between the two parent species (Fraser-Jenkins and Gibby, 1980). The densely glandular fronds, which are fragrant when young, distinguish this species from others in this group.

Dryopteris mindshelkensis was reported in cultivation in the U.S. by Mickel (1994). Spores are available from time to time under the name *D. villarii,* particularly from plants of British origin. This species is hardy to a January average of ca. 30°F and is easily cultivated in soil with abundant limestone. Its fronds are deciduous.

28. Dryopteris stewartii Fraser-Jenk. (Kalikasan 7:272. 1978).—Fig. 29.

Rhizome ascending to erect, producing offshoots. Fronds to 110 cm long, 36 cm wide; stipe ¼–½ the length of the blade, the stipe-base scales dark brown, at times with lighter margins, lanceolate to ovate-lanceolate; blade triangular-lanceolate, 2-pinnate-pinnatifid, the basal pinnae not reduced, the basiscopic pinnules somewhat longer than the acroscopic pinnules on the same pinna; the basal pinnules stalked, triangular-lanceolate, the apex acute, shallowly to deeply lobed, lobes rectangular, their tips rounded, margins with acute teeth. Sori medial 1–2 mm in diameter, indusium thin; spores both fully formed and abortive.

Dryopteris stewartii is an apomictic triploid species from the Himalayan re-

FIG. 28. *Dryopteris mindshelkensis*. A) Frond [scale=5cm]. B) Stipe scale [scale=5mm].

gion, where it grows in forests or along roadsides at mid- to high elevations. It is found in the trade incorrectly as *D. goeringiana* (Kunze) Koidz.

This species is easily cultivated in moist soil. In southern California, the fronds are semi-evergreen. In the fall the stipes bend near their base and the fronds flatten themselves on the ground, where they remain throughout the winter. In the wild, it grows in areas where the average January temperature reaches ca. 45°F.

FIG. 29. *Dryopteris stewartii*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Basal pinna [scale=1cm].

29. Dryopteris sublacera Christ in Lecomte (Notul. Syst. (Paris) 1:43. 1909).— Fig. 30.

Rhizome erect, producing offshoots. Fronds to ca. 70 cm long, 18 cm wide; stipe ⅓–¼ the length of the blade, densely covered with reddish-brown to dark-brown scales with minutely toothed or fimbriate margins, the scales falling off and their bases persisting to leave a slightly roughened surface; blade ovate to ovate-lanceolate, 2-pinnate; pinnae triangular tapering to an acute tip; basal pinnae not reduced; the basal pinnules stalked or narrowly constricted at the

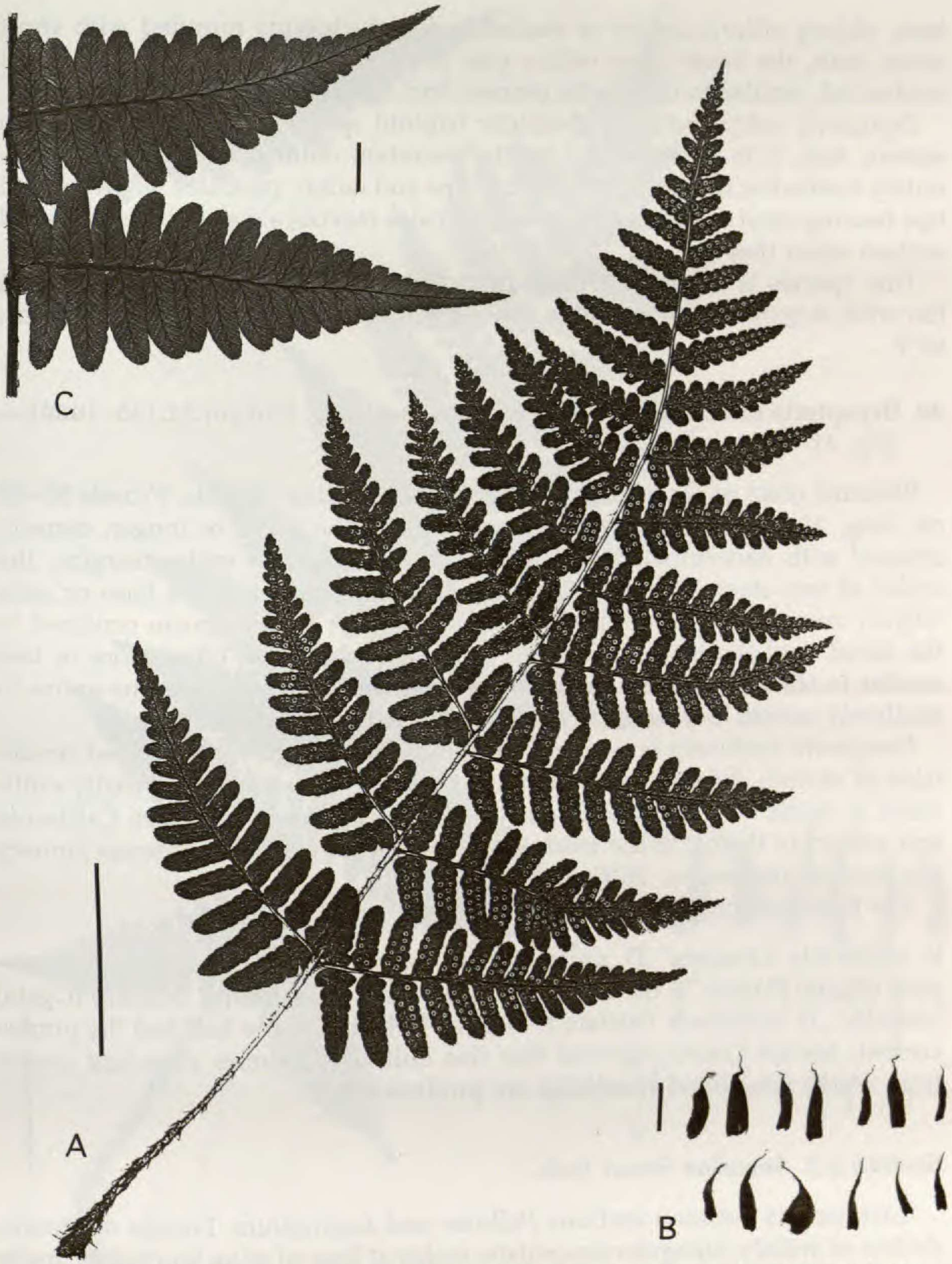


FIG. 30. *Dryopteris sublacera*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Basal pinnae [scale=1cm].

base, oblong elliptic, entire or shallowly lobed, the tips rounded with short acute teeth, the bases often with a pair of enlarged lobes; fertile pinnae not contracted, similar to the sterile pinnae. Sori medial; indusia thick, inflected.

Dryopteris sublacera is an apomictic triploid species ranging from India to eastern Asia. It is characterized by the abundant reddish to dark brown, minutely toothed or fringed scales on the stipe and rachis, pinnules with rounded tips bearing short teeth, and bases of the scales leaving a somewhat roughened surface when they fall off.

This species is easily cultivated in moist soil. Its fronds are evergreen. In the wild, it grows in areas where the average January temperature reaches ca. 60°F.

30. Dryopteris uniformis (Makino) Makino (Bot. Mag. (Tokyo) 23:145. 1909).—Fig. 31.

Rhizome erect or ascending, occasionally producing offsoots. Fronds 50–80 cm long, 15–20 cm wide; stipe ⅓ the length of the blade or longer, densely covered with dark-brown to black scales with fringed or entire margins, the scales of two sizes; blade triangular-lanceolate, broadest at the base or only slightly narrowed, pinnate-pinnatifid to 2-pinnate; fertile pinnae confined to the distal ½ of the blade, not or very slightly contracted, often more or less similar to the sterile ones; pinnules (or segments) with the margins entire to shallowly serrate. Sori medial; indusia with entire margins.

Dryopteris uniformis is a sexual tetraploid species native to wooded mountains of eastern Asia and very common in Japan. This species is easily cultivated in moist soil. It is deciduous to semi-deciduous in southern California and subject to thrips. In the wild, it grows in areas where the average January temperature reaches ca. 25°F.

The following cultivar is found in the U.S.:

D. uniformis 'Crispata' (*D. uniformis* var. *crispata* Ogata; *D. uniformis* f. *crispata* (Ogata) Nameg. & Sa. Kurata, *D. uniformis* "monstrosity *crispata* (Ogata) Nakaike", *D. uniformis* 'Cristata').—Rachis forked in upper half and the pinnae crested. Mickel (1994) reported that this cultivar produces abundant spores from which occasional sporelings are produced.

Section 2.7. Aemulae Fraser Jenk.

Intermediate between sections *Pallidae* and *Lophodium*. Fronds 3-pinnate, deltate or widely triangular-lanceolate; scales at base of stipe lanceolate, matte and concolorous. Spores not minutely spinulose.

31. Dryopteris aemula (Aiton) Kuntze (Rev. Gen. Pl. 2:812. 1891).—Hay-scented wood fern, hay-scented buckler fern.—Fig. 32.

Rhizome erect or ascending. Fronds 20–75 cm long; stipe dark purple-brown toward the base, becoming green near the blade, ½ to as long as the blade, the

FIG. 31. *Dryopteris uniformis*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Medial pinna [scale=1cm].

FIG. 32. *Dryopteris aemula*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

scales scattered, very narrowly lanceolate, pale brown; blade bright yellow-green, triangular-ovate, 3-pinnate-pinnatifid at the base, the basiscopic pinnules of the basal pinnae longer than the other pinnules; pinnules concave on the adaxial side, the margins curled upwards, giving a distinct crinkled ap-

pearance; ultimate segments triangular-lanceolate, lobed and bearing acute teeth; stipe, rachis, midrib and blade bearing minute sessile glands. Sori submedial to medial, indusia bearing minute sessile glands on the margin.

Dryopteris aemula is a sexual diploid species native to Europe, where it grows in moist, acidic soils of shady woods, banks, or hedgerows. It may be recognized by the drooping frond tips and the crinkled appearance of the pinnules resulting from the upward curving of the pinnules, the dark purple-brown stipe, and the concolorous light brown, very narrowly lanceolate stipe scales. Drying fronds emit a fragrance reminiscent of freshly mown hay.

Although slow-growing, the hay-scented wood fern is easily cultivated. It prefers shady, well-drained soils and high humidity. It is semi-deciduous. In the wild, it grows in areas where the average January temperature reaches ca. 45°F.

Section 2.8. Lophodium (Newman) C. Chr. ex H. Itô

Fronds large, 2–3(–4)-pinnate, widely triangular-lanceolate, somewhat glossy and with bicolored or concolorous basal stipe-scales. Lobes of ultimate segments usually narrow, pointed and with long hair-pointed aristate teeth.

KEY TO SECTION *LOPHODIUM*

1. Basal basiscopic pinnule of lowest pinnae shorter than (or equal to) the adjacent pinnule; rachis, blade and young indusia with very small stalked glands . . . . . 37. *D. intermedia*
1. Basal basiscopic pinnule of lowest pinnae longer than (or equal to) the adjacent pinnule, if nearly equal then blade and rachis without small stalked glands
   2. Blade as wide as or wider than long; stipe longer than the blade . . . . . 32. *D. amurensis*
   2. Blade narrower than long; stipe shorter than the blade (see also section 2.7, Aemulae)
      3. Stipe scales of concolorous, pale; length of the basal basiscopic pinnule less than 2 times the length of the basal acroscopic pinnule; medial and distal pinnae usually narrow triangular . . . . . 34. *D. carthusiana*
      3. Stipe scales with a darkened base or central dark band; length of the basal basiscopic pinnule usually 2 or more times the length of the basal acroscopic pinnule; medial and distal pinnae more or less parallel-sided near the middle
         4. Pinnule margins curving under; fronds dark green; stipe scales with a dark central stripe; European . . . . . 35. *D. dilatata*
         4. Pinnule margins flat; fronds medium green; stipe scales tan or with a dark center or base (species difficult to separate)
            5. Stipe scales tan with a dark central stripe; fronds erect or slightly arching; North America and Europe . . . . . 36. *D. expansa*
            5. Stipe scales tan, sometimes darker at the base; fronds widely spreading; North America . . . . . 33. *D. campyloptera*

32. Dryopteris amurensis Christ in Christ & H. Lév. (Bull. Acad. Int. Géogr. Bot. 19:35. 1909).—Fig. 33.

Rhizome short-creeping. Fronds 35–60 cm long, stipe longer than the blade, the stipe scales ovate, uniformly light brown or often with slightly darker center; blade deltoid pentagonal, evergreen, membranous, glabrous above and bearing small scales on veins beneath, 3-pinnate pinnatifid at the base, 2-pin-

FIG. 33. *Dryopteris amurensis*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

natifid above, the basal pinnae ¾ to almost as long as the blade, basal basiscopic pinnule of the basal pinna longer than the adjacent one and 4 times longer than the basal acroscopic pinnule; ultimate segment oblong-ovate, pinnately incised or lobed, softly spine tipped.

Dryopteris amurensis is native to northeastern Asia where it grows in coniferous forests. It is a sexual diploid species that may be distinguished by its

membranous triangular blade which is about as wide as or wider than long and bears small scales along the veins on the abaxial blade surface.

This species is easily cultivated but requires moist soil. It is reported to have been able to withstand harsh winter weather (Rush, 1984). In the wild it grows in areas where the average January temperature reaches ca. 10°F.

33. Dryopteris campyloptera Clarkson (Amer. Fern J. 20:118. 1930).—Mountain wood fern, eastern spreading wood fern.—Fig. 34.
D. spinulosa (O. F. Müll.) Watt var. *americana* (Fisch.) Fernald

Rhizome erect or ascending. Fronds 60–90 cm long, stipe ½ the length of the blade or more, the stipe scales light brown and usually with a dark brown base; blade without glands, broadly ovate-triangular to pentangular, 3-pinnate-pinnatifid at the base, 2-pinnate-pinnatifid above, pinnae lanceolate-oblong, basiscopic pinnule of basal pinnae longer than the adjacent one and 2–4 times longer than the acroscopic one; ultimate segments oblong to oblong-ovate, pinnately incised or lobed, finely spine tipped. Sori medial; indusia without glands or rarely with a few glands.

Dryopteris campyloptera is native to northeastern North America. It is a sexual tetraploid species that originated from a cross of *D. expansa* × *intermedia*. This species is frustratingly similar in appearance to one of its parents, *D. expansa*. *Dryopteris campyloptera* displays fronds with a less erect habit and less delicate texture, and less broad and oval than those of *D. expansa*. In nature, the two species do not overlap in their distribution, except in eastern Quebec and in the Maritime Provinces of Canada. In regions where they do overlap, it is difficult to distinguish *D. campyloptera* from its parental species. This is also particularly true with cultivated plants when the native source of the plant is unknown.

The mountain wood fern is easily cultivated in shady areas or in partial sun in well-drained, moist soil. The fronds are deciduous. In the wild, it grows in areas where the average January temperature reaches 0°F. It is difficult to grow in southern California.

34. Dryopteris carthusiana (Villars) H.P. Fuchs (Bull. Soc. Bot. France 105: 339. 1959).—Spinulose wood fern, toothed wood fern, narrow buckler fern.—Figs. 35, 36.
D. spinulosa (O.F. Müll.) Watt
Thelypteris spinulosa (O.F. Müll.) Nieuwl.
Aspidium spinulosum (O.F. Müll.) Sw.

Rhizome ascending to erect. Fronds 45–75 cm long; stipe ¼–½ the length of the blade, the stipe scales ovate, uniformly tan; blade light-green or yellowish-green, without glands, narrowly triangular-lanceolate to ovate-triangular, 2-(3-) pinnate-pinnatifid proximally, 2-pinnate-pinnatifid distally; pinnae narrowly triangular, the basiscopic pinnules of the basal pinnae longer than the adjacent ones and 2 times or less longer than the basal acroscopic pinnule; ultimate

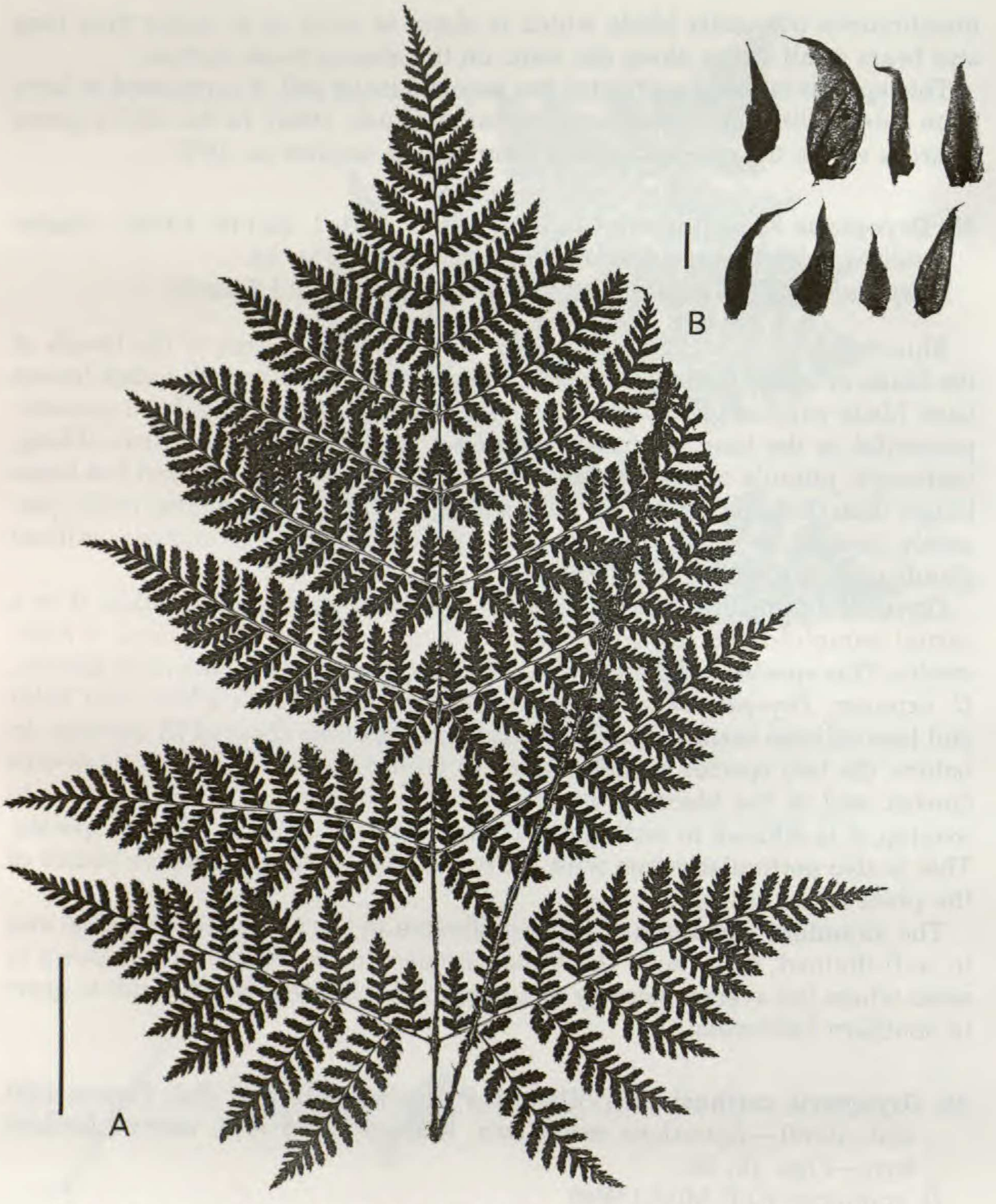


FIG. 34. *Dryopteris campyloptera*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

segments oblong-ovate, pinnately incised or lobed, finely spine tipped, the margins flat. Sori medial; indusia without glands.

Dryopteris carthusiana is found growing in wet woods, stream banks, and swampy areas. It is circumpolar, occurring in North America, Europe, and Asia. It is a sexual tetraploid species that is thought to have originated from a cross between *D. intermedia* and an as yet unidentified species. *Dryopteris*

FIG. 35. *Dryopteris carthusiana*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

carthusiana has triangular-lanceolate blades, and the basal pinnae have basiscopic pinnules that are longer than the adjacent basal pinnules. The stipe scales are uniformly light brown.

This species is easily cultivated in temperate, moist gardens. It is deciduous and not a vigorous grower in southern California. In the wild, it grows in areas where the average January temperature reaches −5°F.

A foliose form is currently available in the trade incorrectly identified as *Dryopteris stewartii* (Fig. 36).

35. Dryopteris dilatata (Hoffm.) A. Gray (Manual, ed. 1, 631. 1848).—Broad wood fern, broad buckler fern.—Fig. 37.

D. austriaca (Jacq.) Schinz & Thell., misapplied

Rhizome erect or ascending, producing offshoots. Fronds 30–150 cm long, stipe ½–¼ the length of the blade, the stipe scales mostly ovate-lanceolate, light brown and with a dark central stripe; blade dark green or bluish-green, without glands, triangular-ovate, 3-pinnate proximally, 2-pinnate-pinnatifid distally, pinnae lanceolate-oblong or triangular; the basiscopic pinnules of the basal pinnae longer than the acroscopic pinnules, ultimate segments oblong-ovate, pinnately incised or lobed, finely spine tipped, the margins turning under. Sori medial; indusia without glands or sometimes glandular.

Dryopteris dilatata is a common, widespread European and western Asia species in damp woods. It is a sexual tetraploid species and is believed to be derived from a cross between *D. expansa* and probably *D. azorica* (Christ) Alston (Gibby and Walker, 1977; Fraser-Jenkins, 1982). The morphological characters of *D. dilatata* are intermediate between those of the supposed parents. It differs from *D. expansa* in having a less dissected frond and more rectangular ultimate segments that have margins tending to curl under, and in having darker scales and a darker green frond. *Dryopteris dilatata* of Europe and *D. campyloptera* (*D. expansa* × *intermedia*) of North America have been shown to be genomically similar and appear to have originated from a cross between related species, but probably resulted from independent crosses (Gibby, 1977). *Dryopteris dilatata* is phytochemically different from *D. campyloptera,* and recent authors have regarded them as distinct (Fraser-Jenkins, 1982). *Dryopteris dilatata* has pinnules that tend to curl under and stipe scales with a central stripe.

This species is semi-evergreen, a robust grower in temperate climates, but in southern California it grows less vigorously. It does best in acidic soils. In the wild, it grows in areas where the average January temperature reaches ca. 25°F.

The following cultivars are reported in the U.S. trade by Mickel (1994):

Dryopteris dilatata 'Crispa Whiteside'.—Crisped foliage and lighter frond color than species.

Dryopteris dilatata 'Cristata'.—Frond and pinna tips crested.

Dryopteris dilatata 'Grandiceps'.—Frond crested forming a dense tassel and crested pinnae.

FIG. 36. *Dryopteris carthusiana* (foliose form). A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Basal pinna [scale=5mm].

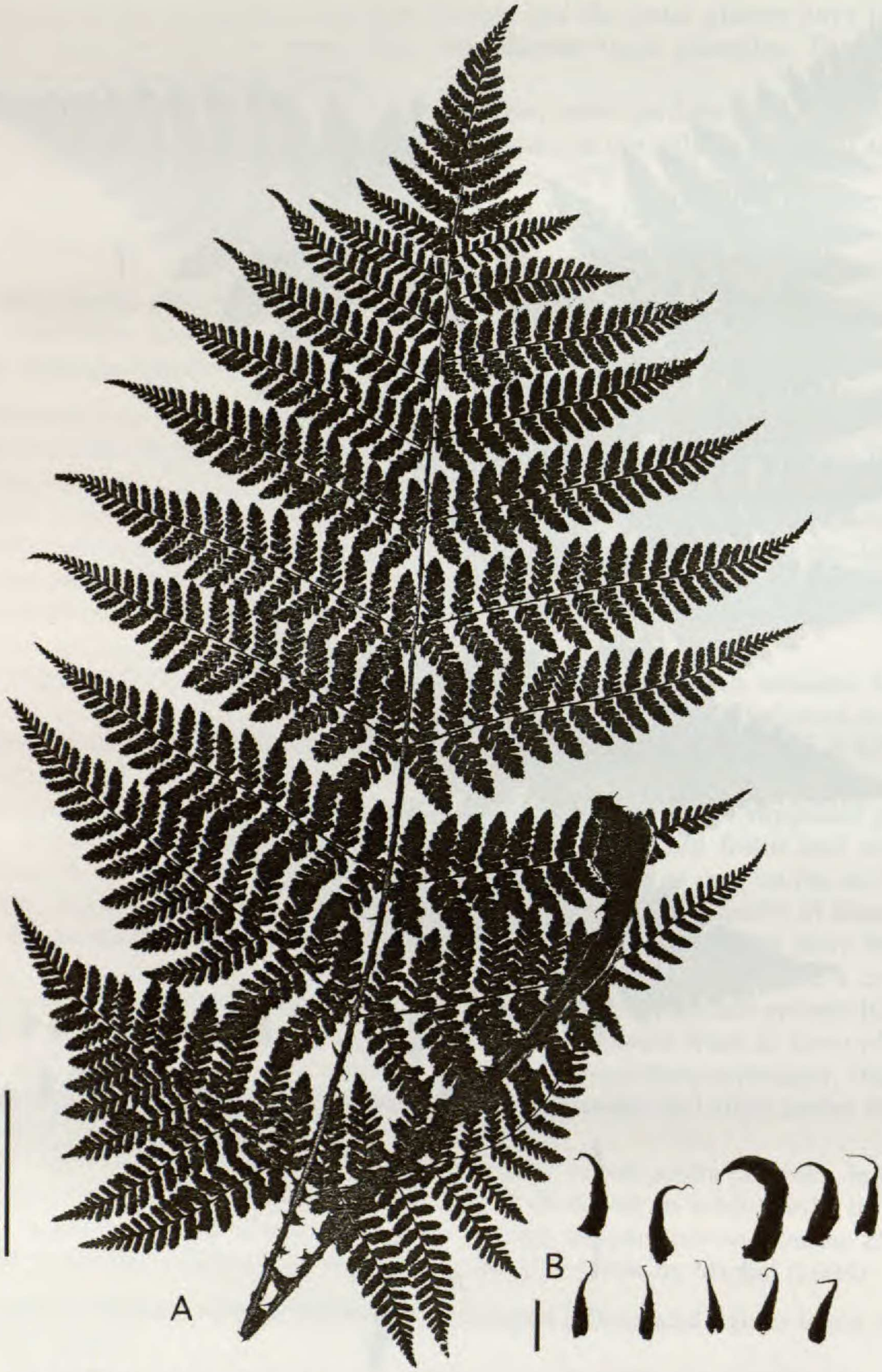


FIG. 37. *Dryopteris dilatata*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

Dryopteris dilatata 'Jimmy Dyce'.—Fronds stiff, erect, blue-green in color.

Dryopteris dilatata 'Lepidota Cristata'.—Fronds finely dissected and crested, 12–18 inches long; stipe and rachis with reddish brown scales.

Dryopteris dilatata 'Recurved Form'.—Margins of the segments curving downward.

36. Dryopteris expansa (C. Presl) Fraser-Jenk. & Jermy (Brit. Fern Gaz. 11:338. 1977).—Arching wood fern, northern spreading wood fern, northwestern spreading wood fern, northern buckler fern.—Fig. 38.
D. dilatata (Hoffm.) A. Gray, in part
D. assimilis S. Walker
D. austriaca (Jacq.) Woyn.

Rhizome erect or ascending, producing offshoots. Fronds 30–90 cm long; stipe ½–⅓ as long as the blade, brown at base, pale green above (rarely darker), the stipe scales light brown, occasionally with a dark brown center; blade without glands, herbaceous, broadly triangular to triangular-ovate, 3-pinnate-pinnatifid proximally, 2-pinnate-pinnatifid distally, pinnae lanceolate-oblong, broad at base, basiscopic pinnules of the basal pinnae longer than the adjacent ones and 2–3 times longer than the acroscopic ones, ultimate segments ovate-oblong, pinnately incised or lobed, finely spine tipped. Sori medial; indusia without glands.

Dryopteris expansa is native to northern Asia, North America, and Europe. It is a sexual diploid species and represents one of the parents of *D. campyloptera,* from which it is difficult to distinguish morphologically. *Dryopteris expansa* differs subtly from *D. campyloptera* in having fronds that are nearly upright and with more broadly triangular, thin, delicate blades and more pointed, falcate segments on proximal pinnae. To differentiate this species with certainty from *D. campyloptera,* the chromosomes need to be examined. *Dropteris dilatata* has been shown to be a taxon distinct from *D. expansa* (Fraser-Jenkins and Jermy, 1977).

This species is easily cultivated in temperate climates. In southern California, it tends to produce new growth late in the spring and is deciduous, but not vigorous. It does not tolerate drying in summer. In the wild, it grows in areas where the average January temperature reaches ca. −5°F.

37. Dryopteris intermedia (Muhl. ex Willd.) A. Gray (Manual, ed. 1, 630. 1848).—Evergreen wood fern, glandular wood fern, fancy fern.—Fig. 39.
D. spinulosa (O.F. Müll.) Watt var. *intermedia* (Muhl. ex Willd.) Underw.

Rhizome ascending. Fronds 35–70 cm long, stipes usually ¼–⅓ the length of the blade, the stipe scales tan; blade oblong-lanceolate, 3-pinnate-pinnatifid proximally, 2-pinnate-pinnatifid distally, bearing minute stalked glands especially at the bases of the pinnae and on the rachis; pinnae with nearly parallel margins tapering only towards the tip, basal pinnae with the basal basiscopic pinnule usually shorter than the adjacent pinnule, ultimate segments ovate-

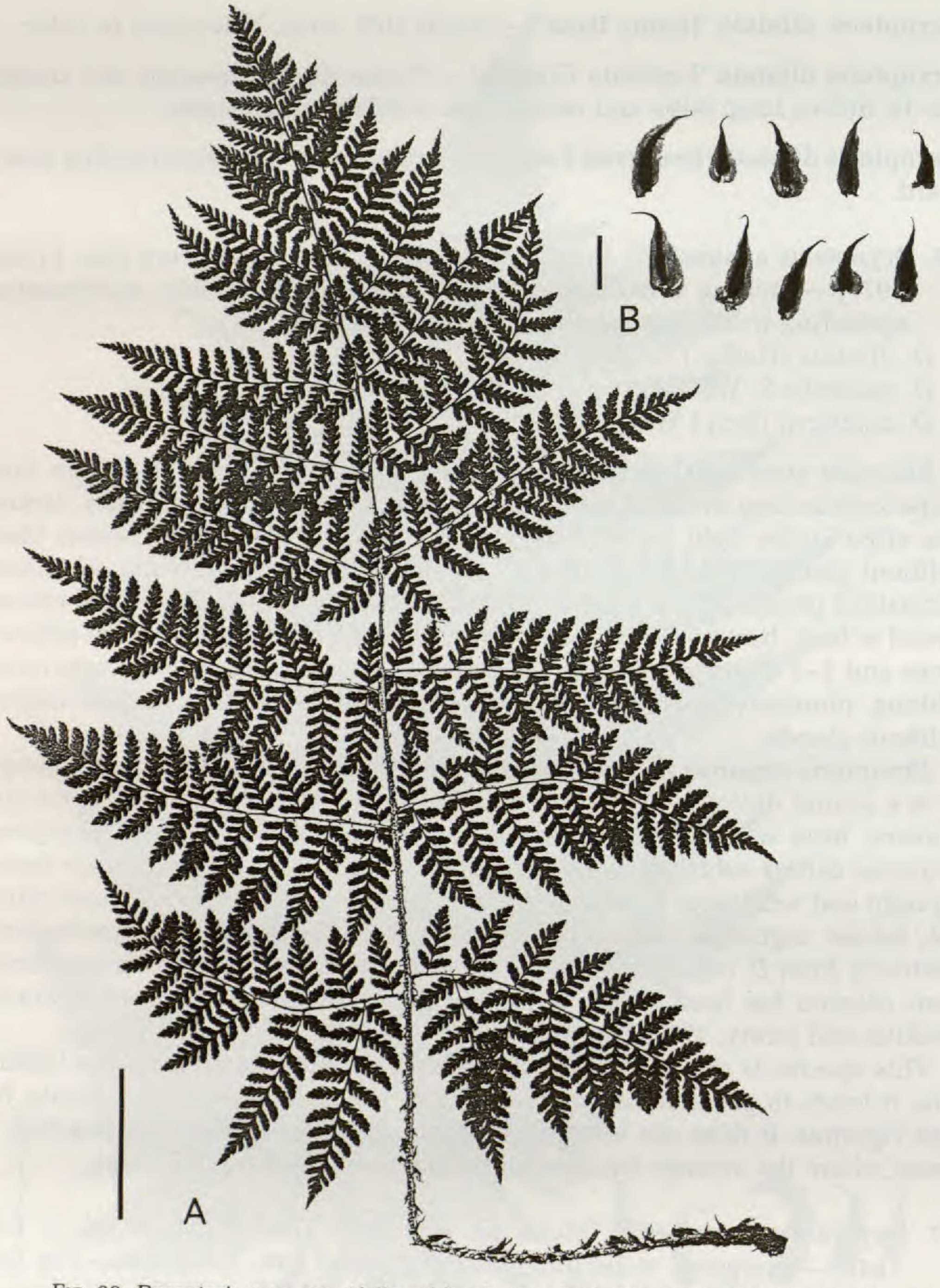


FIG. 38. *Dryopteris expansa*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

oblong, pinnately incised or lobed, finely spine tipped. Sori medial; indusia with minute, stalked, glandular hairs.

Dryopteris intermedia is native to northeastern North America, where it grows in moist woods and swamp margins. It is a sexual diploid species and

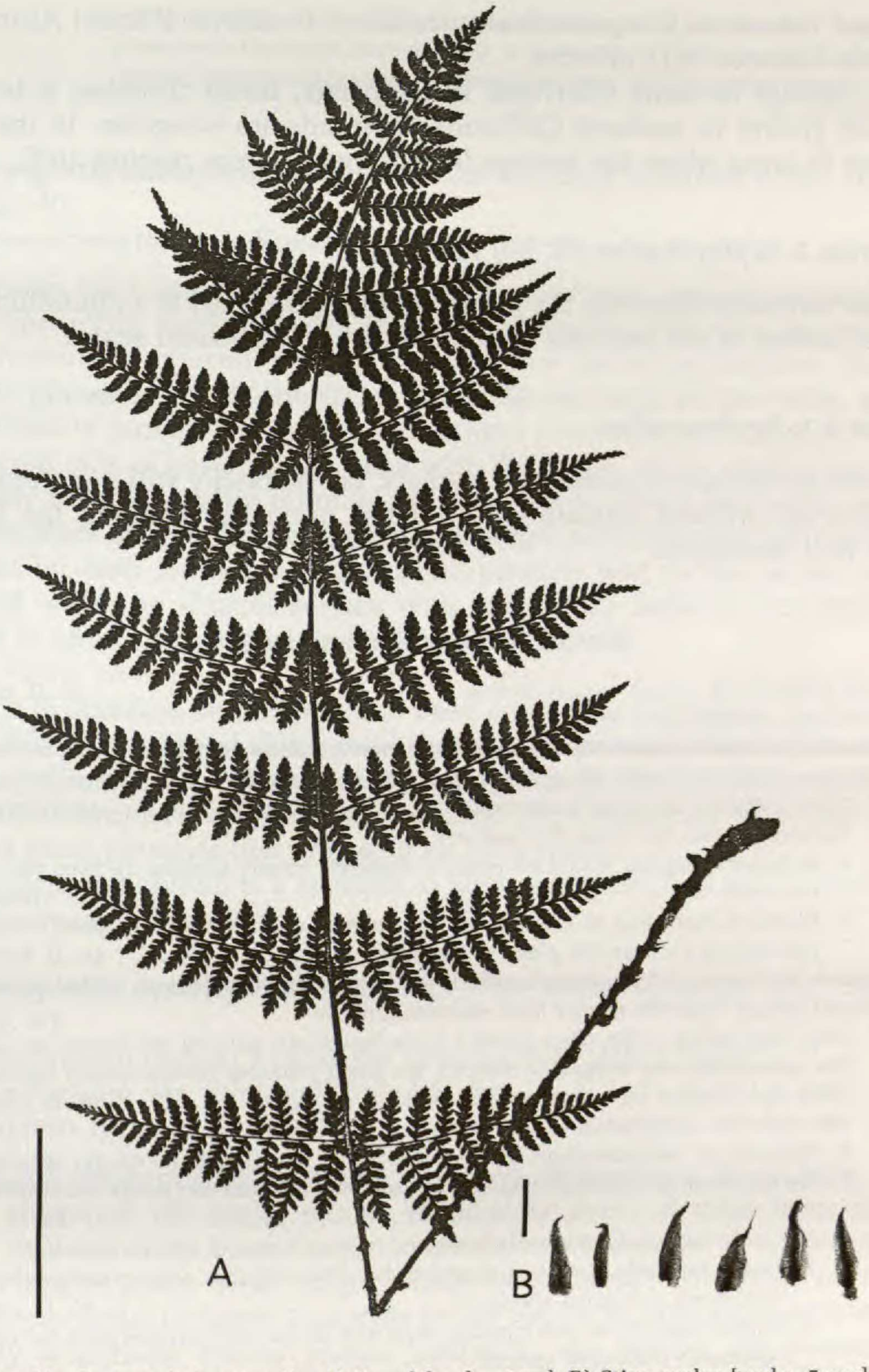


FIG. 39. *Dryopteris intermedia*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

has contributed to the formation of both *D. campyloptera* and *D. carthusiana* as one of their parent species. It is characterized by having lacy blades with short basiscopic pinnules on the proximal pinnae and particularly also by the presence of small stalked glands, resembling pin-heads, on the rachis, pinnae

axis, and indusium. It is genomically similar to *D. azorica* (Christ) Alston, the probable ancestor of *D. dilatata*.

This species is easily cultivated in temperate, moist climates; it is not a vigorous grower in southern California. Its fronds are evergreen. In the wild, it grows in areas where the average January temperature reaches 10°F.

Subgenus 3: Erythrovariae (H. Itô) Fraser-Jenk.

Blade variously dissected, the pinnae gradually reduced to a pinnatifid apex; abaxial surface of the leaf axis with bullate or bullate-based scales.

Section 3.1: Erythrovariae

Fronds herbaceous or somewhat leathery, not markedly stiff nor coriaceous, the pinnules without caudate apices, lobes normally rounded, the bullate scales well developed.

KEY TO SECTION *ERYTHROVARIA*

1. Fronds pinnate, the pinnae crenate-serrate . . . . . 40. *D. decipiens*
1. Fronds more divided, 2- to 3-pinnate
   2. Fronds 3-pinnate at least at the base, the basiscopic pinnules next to the rachis on the lowest pinnae variable in length, often longer than adjacent pinnules
      3. Indusia absent, the blade herbaceous . . . . . 43. *D. gymnosora*
      3. Indusia present, the blade thin leathery
         4. Rhizome creeping; spinulose teeth of segments mostly turning up from the plane of the frond . . . . . 39. *D. cystolepidota*
         4. Rhizome ascending to erect; spinulose teeth of segments usually poorly developed, not turning up from the plane of the frond . . . . . 44. *D. hondoensis*
   2. Fronds 2-pinnate to 2-pinnate-pinnatifid, the basiscopic pinnule next to the rachis on the lowest pinnae typically shorter than adjacent pinnule
      5. Stipe and rachis scales often broadly ovate-lanceolate, shining red-brown or rust color, the costa scales very irregularly shaped, the larger pinnules conspicuously eared on both sides and attached by a short winged stalk . . . . . 38. *D. championii*
      5. Not with this combination of characters
         6. Pinnules or segments short rectangular-oblong, broadly adnate except sessile next to the rachis on proximal pinnae; indusia to 3 mm in diameter; rarely cultivated species . . . . . 42. *D. fuscipes*
         6. Not with this combination of characters; indusia 2 mm or less in diameter
            7. Pinnae typically distant; stipe and rachis pink-purplish; sori typically submarginal; very rarely cultivated species . . . . . 45. *D. purpurella*
            7. Pinnae adjacent or overlapping; stipe and rachis not pink-purplish (or rarely so); commonly cultivated species
               8. Blade mostly elongate-ovate to oblong, less frequently triangular, abruptly tapering to the apex, spreading and arching, the pinnules or segments mostly linear triangular to narrow triangular, their apices bluntly acute; bullate scales many on rachis; sori usually closer to the midrib than medial; very variable species (particularly in degree of pinnule lobing) and difficult to separate from *D. hondoensis* . . . . . 41. *D. erythrosora*
               8. Blade mostly triangular, gradually tapering to the apex, erect and slightly arching, the pinnules or segments narrow triangular or oblong, their apices mostly

rounded; bullate scales fewer on rachis; sori medial (in the wild, larger older plants with the blade more divided, to 3-pinnate or nearly so, and the proximal pinnae conspicuously stalked; this seldom seen in U.S. garden plants) . . . . . 44. *D. hondoensis*

38. Dryopteris championii (Benth.) C. Chr. ex Ching (Sinensia 3:327. 1933).—Fig. 40.

D. pseudo-erythrosora Kodama

Rhizome erect, stout. Stipes to ca. 25 cm, clustered, densely covered with shiny, spreading, reddish brown scales, the scales to 1 cm long, lanceolate to ovate-lanceolate, crisped, margins membranous and erose-fimbriate; blade 2-pinnate-pinnatifid, ovate-triangular, to ca. 50 cm long, 25 cm wide; pinnae pinnatisect to pinnate-pinnatifid, falcate, apex pinnatifid acuminate, the scales on abaxial side of costa dense, some with flat bases, others partly or more or less fully bullate; smaller pinnules oblong-ovate to oblong-lanceolate, sessile, margins more or less crenate, apex obtuse, larger pinnules serrate-incised with auricles on both sides, basal basiscopic pinnule next to the rachis usually reduced, veins on abaxial surface with minute tan hairs (to 0.3 mm). Sori medial to often submarginal; indusia round-reniform.

Dryopteris championii is an apogamous triploid species from eastern Asia, where it is common on hillsides and open areas with light shade. It is distinct by its dense covering of shiny, reddish brown stipe and rachis scales and, on larger specimens, very regular (neat), dark green, glossy, leathery, fronds. It is similar to *Dryopteris erythrosora* in general appearance but with larger, less toothed basal pinnules that are eared on both sides.

Dropteris championii is a medium to large, evergreen fern and is hardy to a January average above 30°F.

39. Dryopteris cystolepidota (Miq.) C. Chr. (Index Filicum 260. 1905).—Fig. 41.

D. erythrosora (Eaton) Kuntze var *cystolepidota* (Miq.) Nakai

D. erythrosora var. *dilatata* (Koidz.) Sugim.

Dryopteris nipponensis Koidz.

Rhizome medium short-creeping, branched. Stipes to ca. 30 cm long, irregularly clustered, the scales mixed, moderately dense at stipe base, sparser above, dull brown to black, larger scales narrow triangular to lanceolate, ca. 10 mm long or more; blade oblong-triangular to broadly triangular, ca. 50 cm long, 28 cm wide, to barely 3-pinnate in the basal area, the blade apex usually abruptly acuminate, lowest pinnae noticeably the longest, the texture thin leathery, slightly glossy, the costae often conspicuously covered with dark bullate scales, the scales when young and fresh often tan to pinkish at their bases and blackish brown distally; pinnules lanceolate-oblong to long narrow triangular, sessile or adnate, the larger ones eared on one or both sides, the margins lobato-incised to serrate-incised, the teeth tipped with 1 (2) small spines, the spines often incurved and on live plants often turned upwards from the adaxial frond surface, the larger pinnules pinnatisect to pinnate, the basiscopic

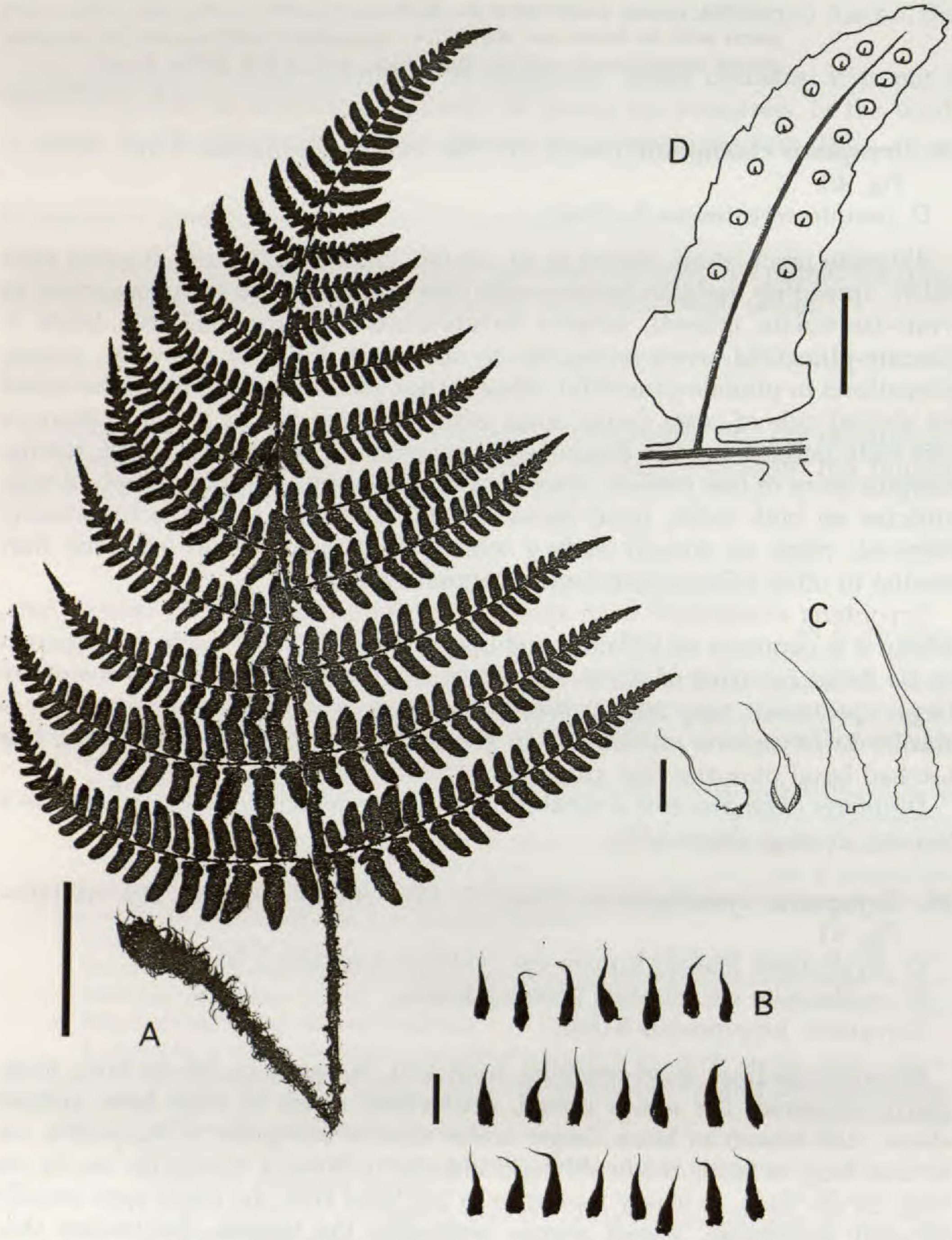


FIG. 40. *Dryopteris championii*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Costal scales [scale=1mm]. D) Pinnule from medial pinna [scale=5mm].

FIG. 41. *Dryopteris cystolepidota*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Basal pinna (Note: Basiscopic pinnule not longest as is usual) [scale=1cm].

pinnule next to the rachis on the lowest pinnae shorter, equal to, or longer than the adjacent pinnule. Sori small, medial; indusia round-reniform, pinkish red in center at maturity.

Dryopteris cystolepidota is an apogamous triploid species that is native to Japan and Korea. The moderately short-creeping rhizome, broad, slightly glossy fronds with an abruptly narrowed tip, the long pinnules, and the often upward-pointing spinulose teeth help in identifying this fern. Although the lengths of the basal basiscopic pinnules next to the rachis vary, they are not as long as those in section *Variae*. The slightly glossy spreading fronds with the new red growth are particularly attractive. Although the rhizome is moderately creeping, the growth is restrained.

This species is of medium size, evergreen, of easy culture, and hardy to January averages slightly below 30°F.

40. Dryopteris decipiens (Hook.) Kuntze (Rev. Gen. Pl. 2:812. 1891).—Fig. 42.

Rhizome ascending to erect, forming offshoots. Stipes 10–35 cm long, clustered, the scales denser at the base, sparser above, very narrowly triangular, to ca. 12 mm long; blade narrowly triangular, to ca. 32 cm long, 18 cm wide, 1-pinnate, the proximal pinnae sometimes with a roundish, nearly free lobe next to the rachis, apex pinnatifid; pinnae linear-lanceolate, truncate to cordate, acuminate, falcate, leathery, margins entire or shallowly crenate to serrate at the apex, rachis and costa with bullate scales. Sori generally closer to the midrib than the margin, often more abundant and scattered at the pinnae base; indusia round-reniform.

Dryopteris decipiens is an apogamous triploid species native to eastern Asia, where it grows among rocks or in shaded areas, usually at higher elevations. It is distinct from other cultivated 1-pinnate *Dryopteris* by its pinnatifid acuminate apex, falcate pinnae, and bullate scales.

It is a small to medium fern, hardy to a January average of above 30°F, semi-deciduous in warm climates, and deciduous elsewhere.

41. Dryopteris erythrosora (Eaton) Kuntze (Rev. Gen. Pl. 2:812. 1891).—Autumn fern.—Fig. 43.

Rhizome erect-ascending to prostrate, stout, branching to form a few adjacent crown. Stipes 30–60 cm long, irregularly clustered, the larger scales mostly very narrow, stiffish, somewhat glossy, blackish brown to black, ca. 10 mm long; blade 30–70 cm long, 15–35 cm wide, typically broadly ovate to oblong, to 2-pinnate; pinnae 8–20 pairs, pinnatisect to pinnate, their apices pinnatifid, acuminate, the bullate scales of the costa fairly persistent, often dense and dark; pinnules narrow-oblong to linear-lanceolate, acute to rounded, the margins subentire, serrate, crenate-serrate or incised-serrate, the teeth mucronate or spinescent and sometimes incurved, the basiscopic pinnule next to the rachis on the lowest pinnae usually reduced. Sori often closer to the midrib than

FIG. 42. *Dryopteris decipiens*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Basal pinna [scale=1cm].

medial; indusia round reniform, quite evenly placed, at maturity red; for greenish white indusia, see f. *viridosora*.

Dryopteris erythrosora is an apogamous triploid species from eastern Asia, where is grows in woods on low mountains and hills. It is a very common and very variable species. Because of its variability, this species is often confused with others. The 2-pinnate, broad frond, the short basiscopic pinnule next to the rachis on the proximal pinnae, the many non-opposite pinnae, and the frequently incurved spinulose tipped teeth, often dark-tipped bullate scales, help somewhat to distinguish it from most U.S. cultivated *Dryopteris*. In the southern California trade, it is much confused with the similar appearing *D. hondoensis* (which see). Plants currently circulating in the Pacific Northwest as *D. bissetiana* and *D. purpurella* are *D. erythrosora* variants, these variants often have more triangular fronds and deeply serrate lobed pinnules than typical *D. erythrosora*. True *D. bissetiana* and true *D. purpurella* (which see) are very rare in U.S. and appear distinctly different.

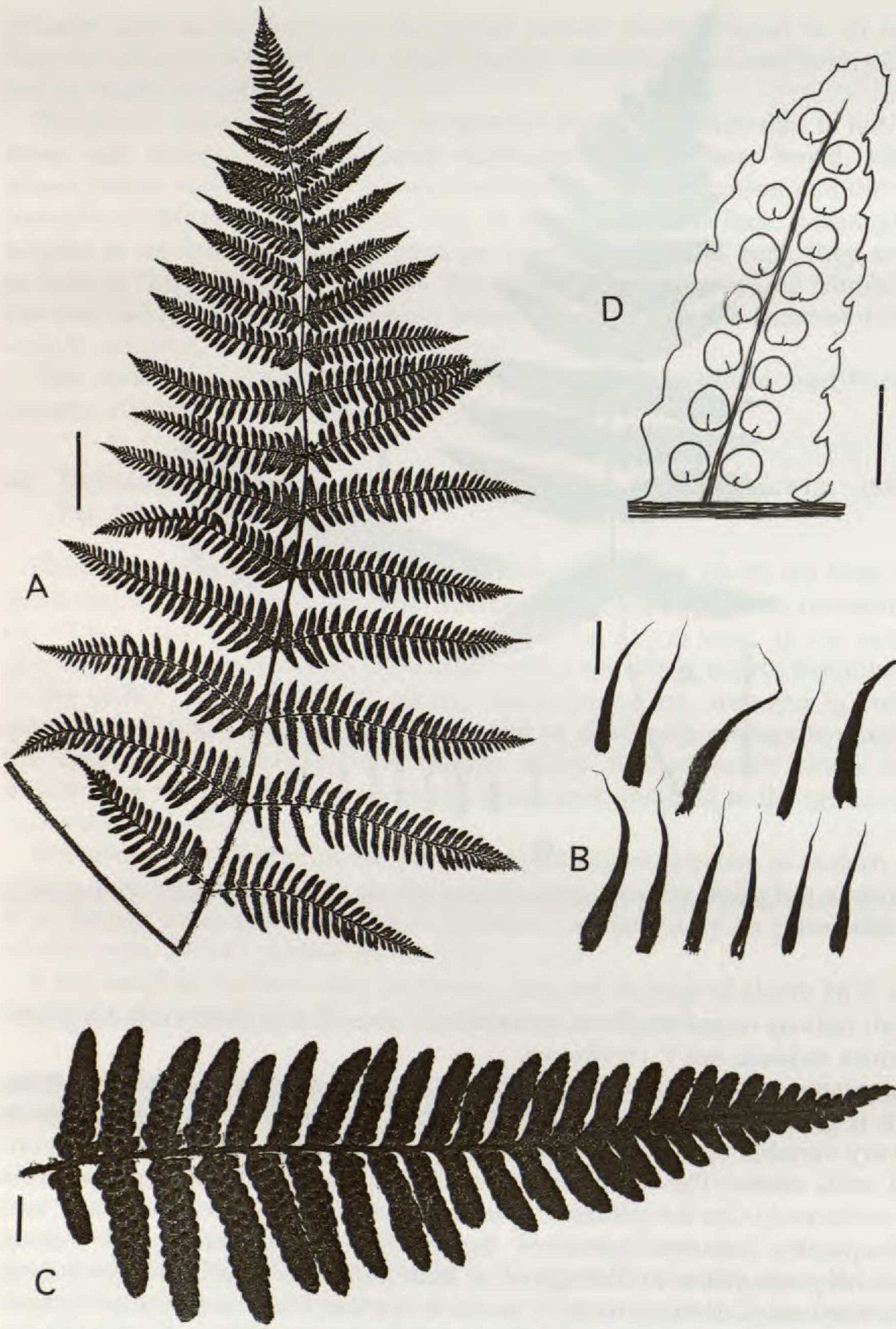


FIG. 43. *Dryopteris erythrosora.* A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Lowest pinna [scale=1cm]. D) Pinnule from medial pinna [scale=5mm].

The range of variability of *Dryopteris erythrosora* in U.S. gardens includes differences in height of the plant, the arching or spreading habit of the fronds, the fullness and shape of the blade and its divisions, particularly the degree of lobing in the pinnules, the intensity of the green blade color, the length of the stipe, thinness or brittleness of the blade tissue, color of the indusia, and also other features.

Dryopteris erythrosora has medium to large fronds and is hardy to a January average somewhat above 30°F. It is a robust grower and easily cultured. The new growth is often a pinkish or reddish bronze, which is more pronounced on some plants than on others. This species is valued for its shiny evergreen foliage. Plants with red or maroon-red indusia provide an added interest.

The following are found in cultivation. These were originally published as formae, but some authors believe that they are best regarded as cultivars:

Dryopteris erythrosora f. prolifica (Maxim. ex Franch. & Sav.) H. Itô in Takai & Honda (Nov. Fl. Jap. 4:41. 1939).—Blade deltoid, often with buds; pinnules strongly contracted, linear shaped, apex sharply pointed. The original plant was found among wild plants in Japan. Small-medium plant of easy culture.

Dryopteris erythrosora f. viridosora (Nakai ex H. Itô) H. Itô (Bot. Mag. (Tokyo) 50:68–69. 1936 [also see H. Itô in Nakai and Honda, Nov. Fl. Jap. 4:41. 1939]).—Indusia when mature whitish green. Native to Japan. The form with white indusia belongs to f. *viridosora*. Judith Jones of Fancy Fronds Nursery, Seattle, Washington (pers. comm.) reports that spores from *D. erythrosora* with the normal greenish white indusia produce plants with red indusia and less frequently with very white indusia. Martin Rickard of England (pers. comm.) also reports that sowings of spores from plants with greenish white indusia yield some plants with red indusia.

42. Dryopteris fuscipes C. Chr. (Index Filicum, Suppl. 2, 14. 1917).—Fig. 44.

Rhizome ascending to erect, slow to form offshoots. Stipes 20–30 cm long, clustered, the scales brown or more normally reddish brown, narrowly triangular, mostly confined to the stipe base, less persistent above and into the rachis; blade triangular, 20–40 cm long, 15–25 cm wide, to 2-pinnate; pinnae pinnatisect to pinnate, lanceolate to narrow triangular, apex pinnatifid, acuminate to attenuate, costae with bullate scales; pinnules mostly oblong, falcate triangular at base of proximal pinnae on large fronds, less than 2.5 cm long, sessile or adnate, apex rounded to truncate, undersurface with fugacious, dark, hairlike scales, margins entire to crenate-serrate, the basiscopic pinnule next to the rachis on the lowest pinnae usually reduced. Sori close to midvein; indusia round-reniform, relatively large, to 3 mm in diameter, whitish tan.

Dryopteris fuscipes is an apogamous triploid species from East Asia. This species is a medium-large fern with few fronds, giving a sparsely foliated aspect. Its narrow pinnae seem to be farther apart from each other than those found on other cultivated species, and, along with the many broad truncate

FIG. 44. *Dryopteris fuscipes*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

pinnules, help in the recognition of the species. Some of the introduced plants were grown from spores collected in China by the senior author.

It is hardy to a January average above 30°F, and is evergreen, although the fronds tend to lie prone in the winter in southern California.

43. Dryopteris gymnosora (Makino) C. Chr. (Index Filicum 269. 1905).—Fig. 45.

Nephrodium gymnosorum Makino

Rhizome short creeping. Stipes 30–50 cm long, slender, sparsely scaly, the basal stipe scales narrowly triangular, 6–8 mm, nearly entire, brown to blackish brown; blade narrowly to broadly ovate, sometimes nearly deltoid, 24–45 cm long, 18–30 cm wide, herbaceous, somewhat narrowed in distal part, acuminate; pinnae broadly lanceolate or narrow long-triangular, 3–6 cm wide, nearly sessile, apex caudate-acuminate, proximal pinnae with basiscopic side larger, and the pinnule next to the rachis often the longest; pinnules mostly broadly lanceolate, ca. 1.5 cm long, 5–22 mm wide, sessile, pinnately lobed to parted, toothed, apex rounded to subacute. Sori medial; indusia absent.

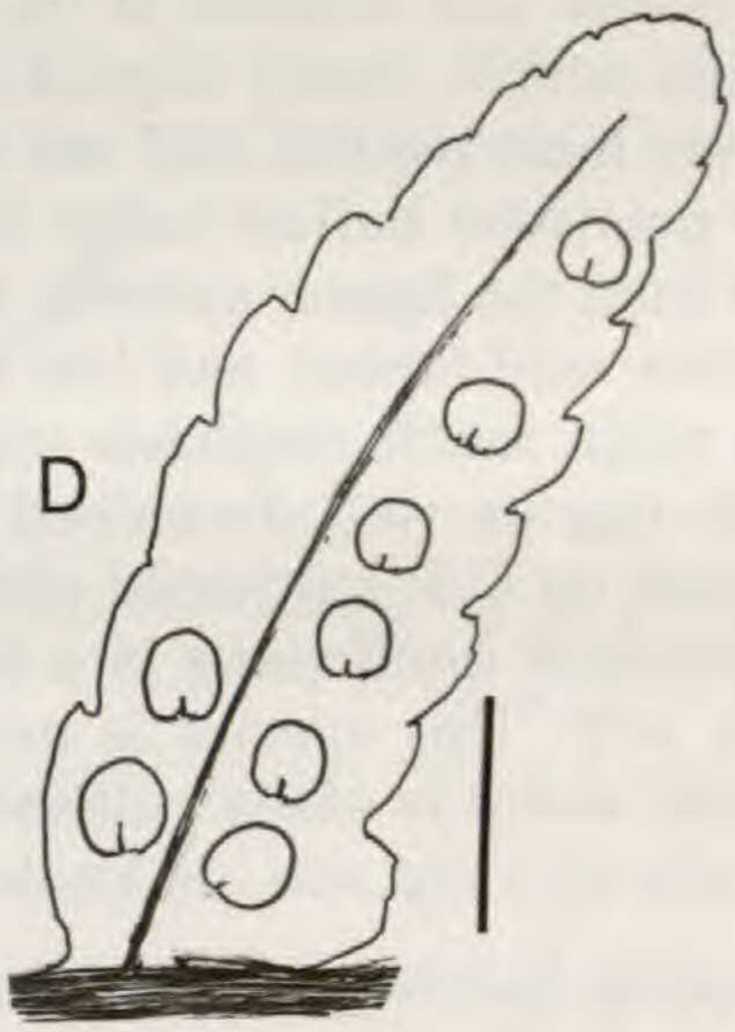
Dryopteris gymnosora is an apogamous triploid species native to eastern Asia. This species is occasionally listed in specialty catalogs in the U.S., and we have not been able to obtain U.S. material for verification. The herbaceous blade, the often long basiscopic pinnule next to the rachis on the proximal pinnae, and the absence of indusia are the easiest identifying features.

44. Dryopteris hondoensis Koidz. (Acta Phytotax. Geobot. 1:31. 1932).—Fig. 46.

Rhizome ascending to sometimes short-creeping, branching to form inconspicuous crowns slightly distant from one another. Stipes in clusters, the scales light brown to blackish brown, larger scales narrowly triangular to ca. 10 mm long, dull, margins entire or sometimes with occasional fimbriations; blade triangular (frond 50–70 cm long), 2-pinnate to 3-pinnate or nearly so on larger fronds of old plants; bullate scales of the costa mostly light to medium brown, usually falling, frequently absent; pinnae pinnatifid to pinnate, apex pinnatifid to an acute or acuminate apex (proximal pinnae conspicuously stalked on more divided fronds on native plants); pinnules oblong, the margins incised-lobed or serrate, toothed, the apical teeth mostly acute or short spinescent, the basiscopic pinnule next to the rachis on the lowest pinnae usually reduced. Sori medial; indusia round-reniform, grayish white (for red indusia see f. *rubisora*).

Dryopteris hondoensis is an apogamous triploid species from Japan. When young, this species looks very much like *D. erythrosora* and is often sold as such in the trade. At maturity, *Dryopteris erythrosora* is a larger, less compact plant, and its fronds tend to be more oblong and arching rather than more triangular and spreading with little arching as in *D. hondoensis*. *Dryopteris erythrosora* has a very stout crown that may divide to form more crowns adjacent to each other, whereas crowns of *D. hondoensis* are smaller and more distant. Stipe scales of *D. erythrosora* are darker, appearing somewhat stiff and glossy with smooth margins, but those of *D. hondoensis* are a lighter color, appearing softer, dull with slightly irregular margins sometimes bearing a few fimbriations. Other less consistent differences are: the pinnules or segments of *D. erythrosora* are narrower and more pointed, whereas those of *D. hondoensis*

FIG. 45. *Dryopteris gymnosora*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Lowest pinna [scale=1cm].



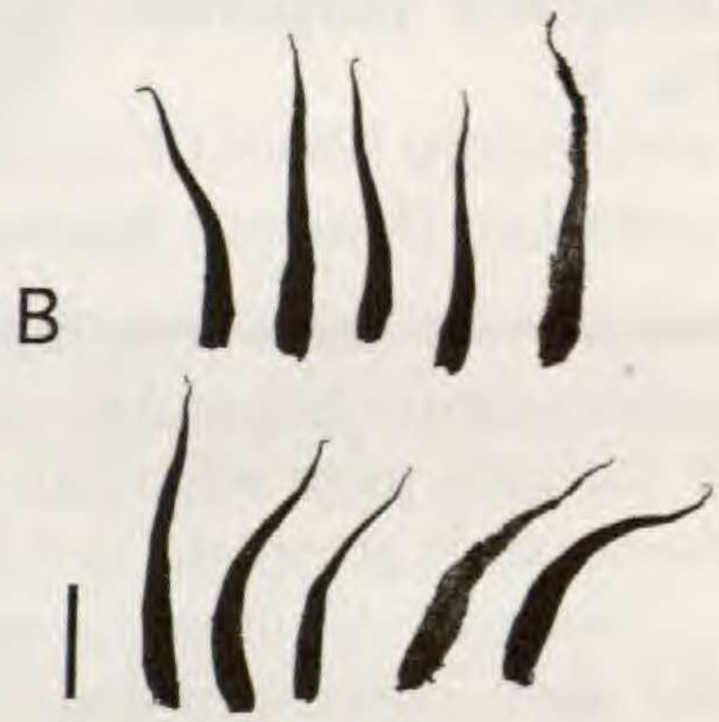


FIG. 46. *Dryopteris hondoensis*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Basal pinna [scale=1cm]. D) Pinnule from medial pinna [scale=5mm].

are broader and rounder at the apex; the indusia are generally closer to the pinnule midrib, neatly aligned and closely placed, in *D. erythrosora,* whereas they are more medial, and not so closely placed in *D. hondoensis*; the darker more persistent bullate scales and more brittle fronds of *D. erythrosora* differ some from the lighter colored, less persistent bullate scales (said to be absent on some wild forms), and less brittle fronds of *D. hondoensis*. Japanese botanists place much emphasis on the conspicuously stalked proximal pinnae found only on well developed fronds of older plants. This stalk is not conspicuous on U.S. cultivated plants.

Dryopteris hondoensis is a medium size fern hardy to a January average above 30°F. This species is more or less evergreen, with new growth often reddish, and it is easily cultivated.

Plants with red sori are known as follows:

Dryopteris hondoensis f. rubisora Kurata (J. Geobot. 13(2):42. 1964).—Differs in the red rather than grayish white color of the indusia.

45. Dryopteris purpurella Tagawa (Acta Phytotax. Geobot. 1:307. 1932).—Fig. 47.

D. erythrosora (Eaton) Kuntze var. *purpurescens* H. Itô

D. indusiata (Makino) Makino & Yamam. var. *purpurescens* (H. Itô) Kurata

Rhizome very short-creeping to ascending. Stipes 20–30 cm long, purplish, the scales narrow triangular, cordate at base and then often narrowing gradually or abruptly to an attenuate gland tipped apex, pale margined or not, brown and black or all greenish, to 7.5 mm long; blade ca. 30–45 cm long, 20–35 cm wide, triangular to broad-ovate, mostly 2-pinnate, abruptly narrowing to a pointed apex, rachis purplish; pinnae lanceolate to narrow triangular, pinnatisect to pinnate, acute to acuminate, attached at right angles or nearly so to the rachis, often somewhat distant, costa with tannish bullate scales; pinnules oblong to elongate elliptic, the teeth somewhat narrow triangular-mucronate; the pinnule next to the rachis on the lowest pinnae only slightly reduced, sometimes pinnatifid. Sori typically submarginal; indusia round-reniform, whitish tan and faintly pink at center, slightly convex.

Dryopteris purpurella has been reported as having both triploid and tetraploid races, both apogamous (Hirabayashi, 1974). It is native to Japan. It is an attractive, medium-sized fern that grows with restraint and has an interesting color in the new foliage. Only a few plants exist in U.S. and have recently been introduced from Yakushima, Japan, by the senior author. The purplish stipe and rachis, the 2-pinnate flatter fronds with ca. 6 pinnate pinnae well spaced apart, the proximal pinnae at or nearly at a right angle to the rachis, and the submarginal sori help to discriminate *D. purpurella*.

According to several Japanese botanists, some of the U.S. cultivated material sold as *D. purpurella* is not that species, although the stipe and rachis may initially be pinkish. In this U.S. material, the larger fronds are basally 2 pinnate-pinnatifid to almost 3 pinnate, with ca. 10 pinnae (contrast with description above) that are broader and closer together, and the basiscopic pinnule

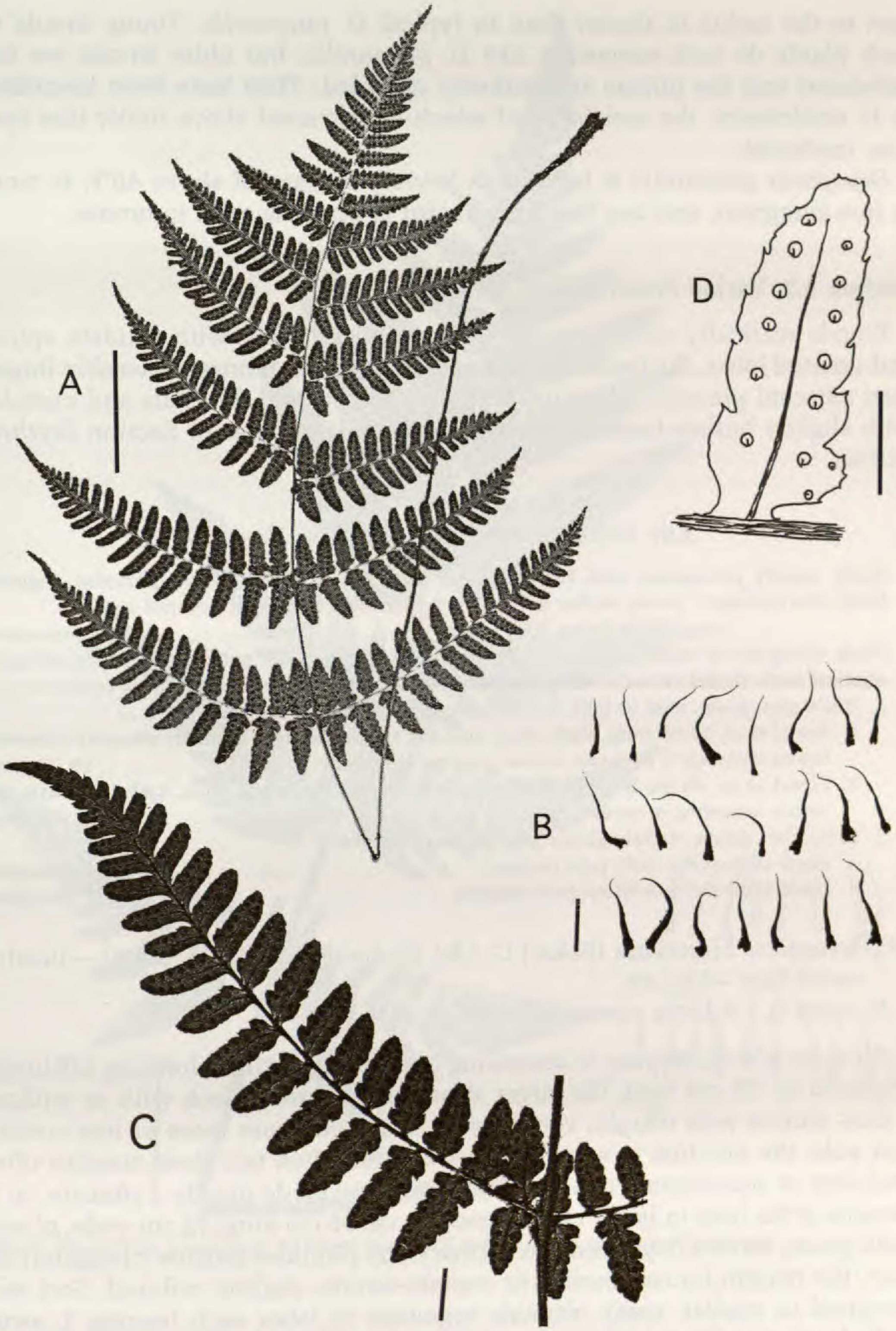


FIG. 47. *Dryopteris purpurella*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Basal pinna [scale=1cm]. D) Pinnule from medial pinna [scale=5mm].

next to the rachis is shorter than in typical *D. purpurella.* Young fronds of such plants do look somewhat like *D. purpurella,* but older fronds are too foliaceous and the pinnae are markedly crowded. They have been identified as *D. erythrosora,* the variability of which is discussed above under that species' treatment.

Dryopteris purpurella is hardy to a January average of above 40°F, is more or less evergreen, and has new growth that is purplish pink to bronze.

Section 3.2: Variae Fraser-Jenk.

Fronds markedly stiff, coriaceous, the pinnules often with caudate apices and pointed lobes, the basiscopic pinnule of the basal pinnae noticeably longer than adjacent pinnules, the stipe scales all narrow and the costa and costules with slightly bullate-based scales (vs. more bullate scales of Section *Erythrovariae*).

KEY AND DESCRIPTION TO SECTION *VARIAE*

1. Blade usually pentagonal with conspicuously elongate, basal basiscopic pinnules, segment teeth short-aristate, young rachis not mottled with dark and light colored scales . . . . . 47. *D. formosana*
1. Blade triangular or weakly pentagonal, basal basiscopic pinnule not conspicuously elongate, segment teeth absent or rarely aristate, young rachis mottled with light and dark colored scales
   2. Blade gray-green, matt or dull, thickish, somewhat stiff
      3. Frond to ca. 90 cm long, blade thick, stiff and rough textured, typically abruptly narrowed before tapering to the apex, scales on stipe and rachis ascending . . . . . 50. *D. varia*
      3. Frond to ca. 40 cm long, blade firm, gradually tapered to the apex, scales on stipe and rachis spreading or recurving . . . . . 49. *D. saxifraga*
   2. Blade dark green, slightly glossy, thin leathery, flexible
      4. Basal stipe scales with pale margins . . . . . 48. *D. sacrosancta*
      4. Basal stipe scales without pale margins . . . . . 46. *D. bissetiana*

46. Dryopteris bissetiana (Baker) C. Chr. (Index Filicum 245. 1905).—Beaded wood fern.—Fig. 48.

D. varia (L.) Kuntze var. *setosa* (Thunb.) Ohwi

Rhizome short-creeping to ascending or erect, sometimes forming offshoots. Stipes to ca. 55 cm long, the larger stipe scales mostly black with or without a faint narrow pale margin, very narrow triangular, base more or less cordate and pale, the medium to smaller scales stouter, often tan, their margins often fimbriate or sometimes irregularly dentate-erose; blade mostly 2 pinnate, to 3-pinnate at the base in larger older fronds, to ca. 55 cm long, 32 cm wide, glossy, dark green, texture firm, medium leathery, the pinnules narrow triangular, falcate, the margin incised-serrate to crenate-serrate, slightly reflexed. Sori submarginal to medial, many ultimate segments or lobes each bearing 1 sorus; indusia at maturity greenish, round-reniform.

Dryopteris bissetiana is an apogamous triploid species native to eastern Asia. The somewhat blunt lobes with recurved margins and slightly embossed adaxial surface gives pinnules of this species a bead-like look, hence the common

FIG. 48. *Dryopteris bissetiana*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

name, beaded wood fern. Some plants currently circulating as *D. bissetiana* in the trade are actually a variation of *D. erythrosora* (recognized by the short rather than long basiscopic pinnules of *D. bissetiana*). Other presently cultivated plants were grown from spores that were collected in a fruit orchard

near Guilin, China, by the senior author. The longer stipes give the plant a more open look than others of this group. *Dryopteris hikonensis* (H. Itô) Kurata (*D. pacifica* (Nakaike) Tagawa), although presently rarely cultivated, may be confused with the closely related *D. biessetiana*. The blades of *D. hikonensis* abruptly narrow near the apex, and its segments are minutely dentate, whereas blades of *D. bissetiana* are gradually narrowed toward the apex and its segments are nearly entire.

Dryopteris bissetiana is a medium-sized, evergreen fern with dark green foliage and a bead-like texture to the frond. It is hardy to a January average of ca. 25–30°F.

47. Dryopteris formosana (Christ) C. Chr. (Index Filicum 266. 1905).—Fig. 49.

Rhizome erect-ascending to short creeping, branching to form a few crowns. Stipes to ca. 30 cm long, the basal stipe scales black-brown, a pale margin inconsistently present, narrowly triangular, the larger ones to 15 mm long, base slightly cordate to truncate, distal stipe scales narrowly lanceolate, black, slightly irregularly dentate, the costa scales long lanceolate or bullate, the bullate scales often with the narrowed part dark; blade broadly pentagonal, to 3 pinnate, the basal pinnae with the basiscopic side larger, the pinnule next to the rachis often noticeably longer than adjacent pinnules, the larger pinnules often slightly auriculate, more so on the distal side, the margins of the pinnules and segments mostly serrate-aristate, the segments oblong to narrowly ovate, rounded to acute, often with two teeth at the apex. Sori medial; indusia round-reniform.

Dryopteris formosana is an apogamous triploid species from Japan and Taiwan. The fairly consistent, broad, pentagonal frond is a helpful identifying feature for this species, along with the relatively long basiscopic pinnule next to the rachis. These and other features indicate that this species is not closely related to the other three species treated in this section.

This species is a medium-sized, nearly evergreen fern with erect-arching growth and broad, finely divided fronds. It is hardy to January averages of 35°F or lower. *Dryopteris formosana* is of restrained growth and is easily cultivated.

48. Dryopteris sacrosancta Koidz. (Bot. Mag. (Tokyo) 38:108. 1924).—Fig. 50.
D. varia (L.) Kuntze var. *sacrosancta* (Koidz.) Ohwi

Rhizome ascending to erect, occasionally producing offshoots. Stipes to ca. 40 cm long, the larger basal stipe scales very narrow triangular, ca. 10 mm long, shiny black with a very narrow pale margin, margins more or less dentate, the stipe scales above weakly cordate, lighter colored at the base, clathrate, the cells oriented in swirls; blade narrowly triangular, to ca. 50 cm long, 3-pinnate, somewhat glossy, green, the margins quite flat, the pinnae tending to overlap, the larger segments subentire to weakly and irregularly serrate to serrate-lobed. Sori submarginal; indusia reniform.

Dryopteris sacrosancta is an apogamous triploid species from eastern Asia.

FIG. 49. *Dryopteris formosana*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm]. C) Pinnule from medial pinna [scale=5mm].

The larger, flatter blade and margins help to distinguish it from *D. bissetiana*, which has a smaller blade with the divisions positioned in slightly different planes and the margins reflexed. The adaxial blade surface of *D. bissetiana* is often slightly embossed on the surface, and the plant has a more open habit

FIG. 50. *Dryopteris sacrosancta*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

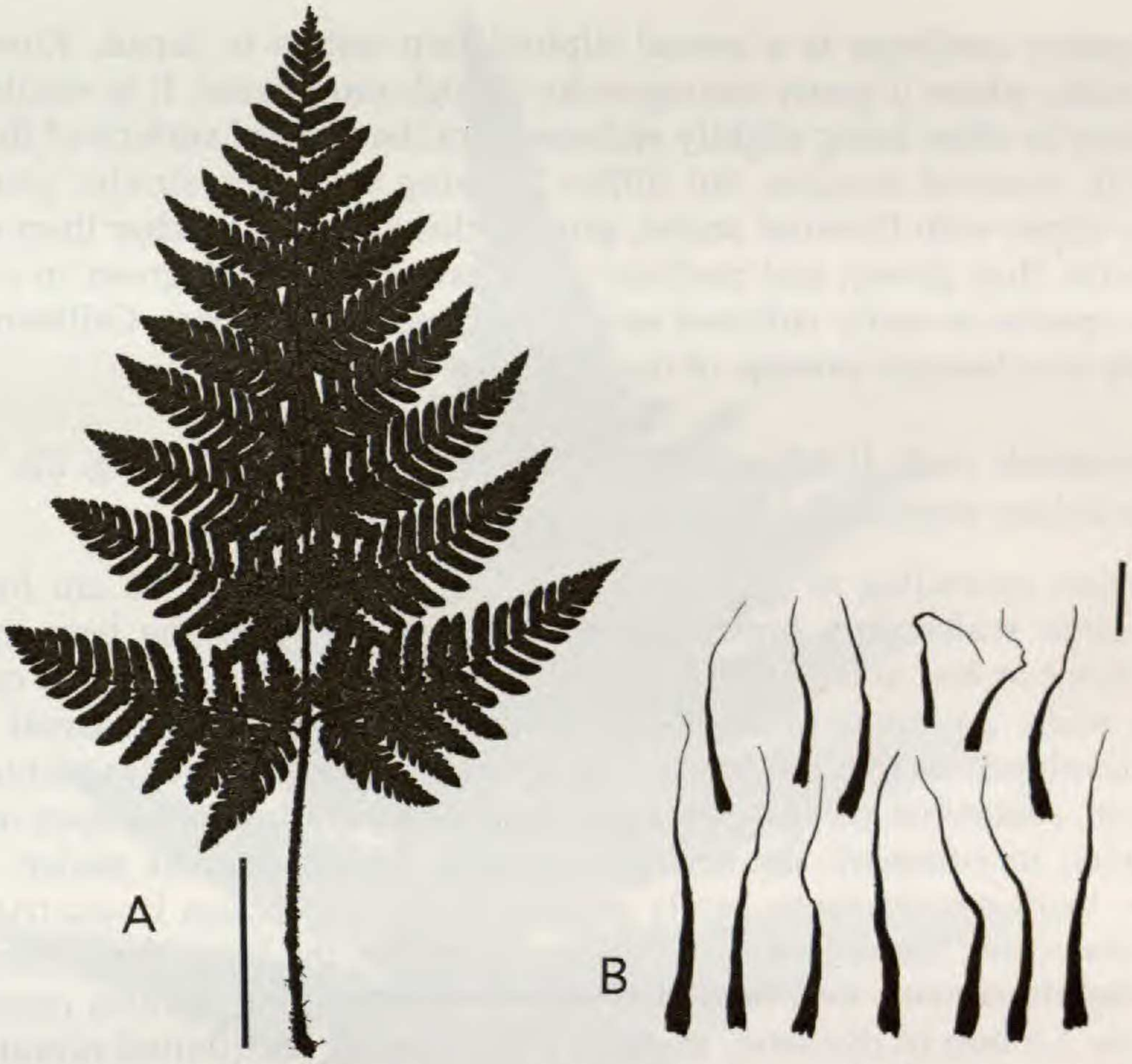


FIG. 51. *Dryopteris saxifraga*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

mainly, due to the longer, more erect stipes. Plants in the trade have been grown from spores taken from a plant collected in 1982 at Toho University, Chiba, Japan, by the senior author.

This species is hardy to a January average of 30°F. It is evergreen and slower-growing than *D. bissetiana*.

49. **Dryopteris saxifraga** H. Itô (Bot. Mag. (Tokyo) 50:125. 1936).—Fig. 51.
Polystichum varium (L.) C. Presl, misapplied

Rhizome ascending to erect, branching to form offshoots. Fronds 35–40 cm long, 10–15 cm broad; stipes ca. half the length of the blade; stipe scales black-brown, to 2 cm long, larger scales long, narrowly triangular with a narrow pale margin, long-tapering to a hair-tip, base pale, cordate, scales on distal part of stipe becoming paler and broader at their base; blade ovate-triangular, 2-pinnate-pinnatifid, smaller pinnules with margins slightly turned under, sinuate, the rachis scales mixed, larger ones ovate-triangular, their bases hardly to slightly pouched, the apices long tapered, hair-like, dark, the smaller scales short-ovate, bullate, light tan, with hair-like apices, the costa scales half the size of rachis scales, roundish ovate, very bullate. Sori in 2 rows on pinnules, medial or closer to midrib; indusium ca. 1 mm in diameter.

Dryopteris saxifraga is a sexual diploid fern native to Japan, Korea, and Manchuria, where it grows among rocks in high mountains. It is similar to *D. bissetiana* in often being slightly embossed on the adaxial surface of the blade and with recurved margins, but differs in being a smaller, stouter plant with shorter stipes with browner scales, pinnae closely placed rather than distant, dull rather than glossy, and medium green rather than dark green in color.

This species is easily cultured and is evergreen in southern California, and is hardy to a January average of ca. 10°F.

50. **Dryopteris varia** (L.) Kuntze (Rev. Gen. Pl. 2:814. 1891).—Fig. 52.
Polystichum varium (L.) C. Presl

Rhizome ascending to very short creeping. Stipes to ca. 45 cm long, the larger stipe scales dark brown-black, often paler toward the base, cordate; blade more or less erect, stiffish, mostly oblong triangular, to ca. 45 cm long, 43 cm wide, 2-pinnate-pinnatifid to 3-pinnate at the base, proximal pinnae more developed on the basiscopic side (on older plants the blades texture thick and hard, somewhat abruptly narrowed and then tapering to the apex and dull gray-green in summer), the segment margins slightly turned under, weakly serrate, teeth mostly acute, rarely aristate, the rachis scales linear-triangular, the costa scales linear lanceolate, many dilated at the base, their base flat to very slightly convex. Sori medial to mostly submarginal; indusia round reniform, ca. 1.5 mm in diameter, margins with sparsely distributed minute hairs.

Dryopteris varia has been reported to consist of both diploid and triploid, apogamous races (Hirabayashi 1974; Fraser-Jenkins; 1989). It is native to northeastern India (rare) and eastern Asia. In southern California the foliage is bronzish when emerging and somewhat gray-green when old and stiff. The overall thicker stiff texture and triangular to oblong pentagonal frond are useful for overall identification. The abrupt narrowing of the apex before tapering to the blade tip is not always strikingly apparent on all fronds. Of more definitive help are the flatter bullate scales which may have a noticeable long apex, and the thick, rougher texture of the frond. This species was known in cultivation in southern California in 1970s. It was grown from spores collected in Japan.

This species is hardy to a January average of ca. 35°F. It is more or less evergreen, has sparse fronds, the emerging ones yellow to rusty bronze. It is of slow growth but not difficult to cultivate.

Addenda

The following taxa of *Dryopteris* have not been treated in the preceding text. These have recently been reported by commercial growers and hobbyists, but have not been confirmed or are very recent introductions. Should the reader desire more details beyond those we have given here, we refer you to the description of the Sections and then also to appropriate floras. Most of the species from the Sino-Himalayan area were introduced into cultivation by Christopher Fraser-Jenkins and are described in Fraser-Jenkins (1989). Japa-

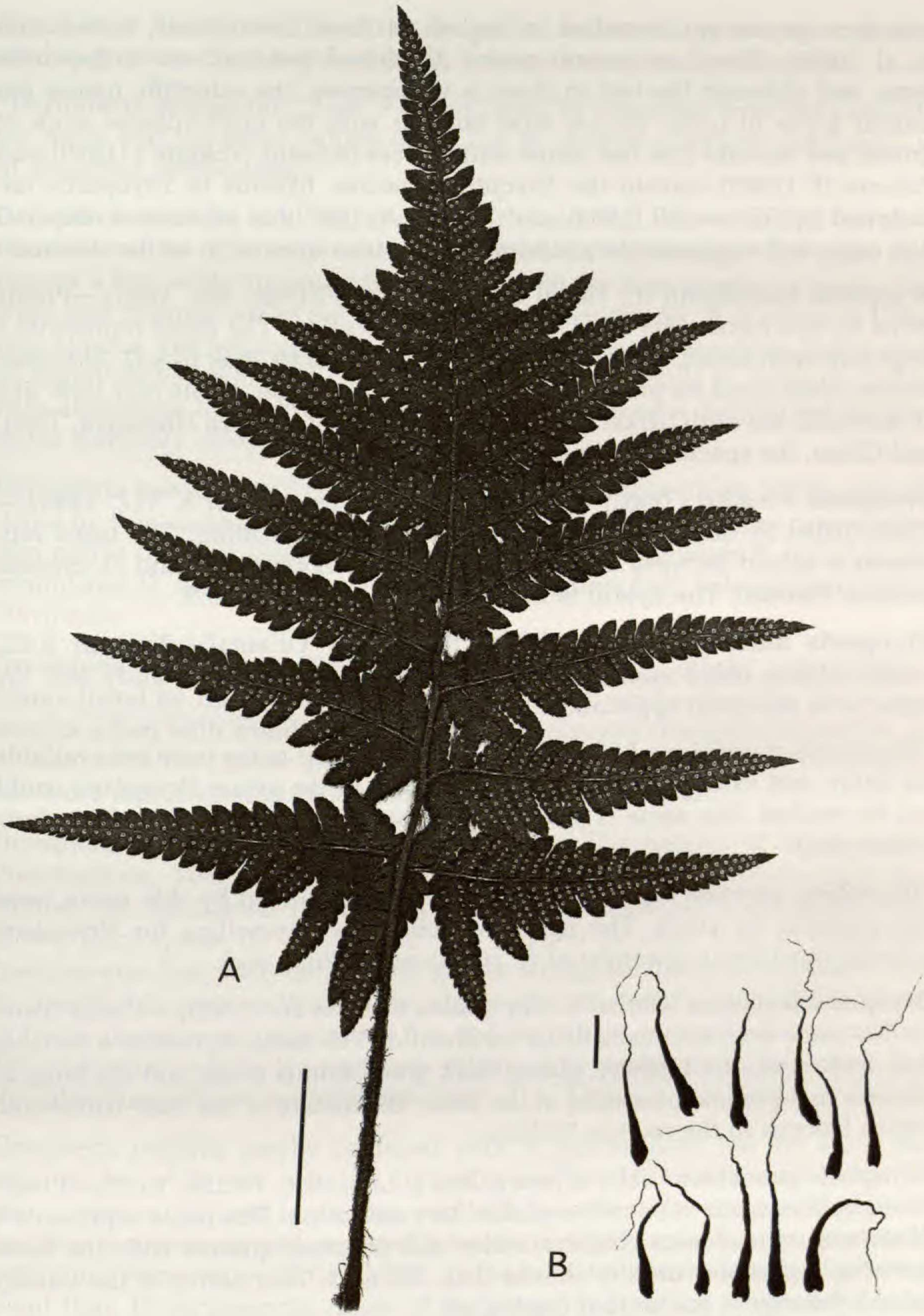


FIG. 52. *Dryopteris varia*. A) Frond [scale=5cm]. B) Stipe scales [scale=5mm].

nese fern species are described in English, without illustrations, in Iwatsuki et. al (1995). There are several recent illustrated publications on Japanese ferns, and although the text in these is in Japanese, the scientific names are usually given in Latin. We are most familiar with the eight-volume work of Kurata and Nakaike that has names and indices in Latin. Volume I (1979) and Volume IV (1985) contain the *Dryopteris* species, hybrids in *Dryopteris* are included in Volume VII (1994), and Volume 8 (1997) has additional distribution maps and supplementary information for taxa covered in earlier volumes.

Dryopteris blandfordii (C. Hope) C. Chr. (Index Filicum 254. 1905).—Plants listed by this name were not available for verification. The name represents a large fern with fronds to ca. 90 cm tall. Mid-size plants look like *D. filix-mas,* but are more lobed on proximal pinnules, whereas larger plants may look like *D. stewartii,* but with darker stipe scales. A native of western Himalaya, Tibet, and China, the species is in section *Remotae.*

Dryopteris ×boottii (Tuck.) Underw. (Native Ferns, edition 4, 117. 1893).—Plants listed by this name were not available for verification. The name represents a hybrid between *D. intermedia* (section *Lophidium*) and *D. cristata* (section *Pandae*). The hybrid is native to the northeastern U.S.

Dryopteris buschiana Fomin (Flora Sibiriae et Orientalis Extremi 5:52. 1930).—Plants listed under this name were not available for study and the name is of uncertain application.

"Dryopteris claytoniana," Hort.—Plants listed by this name were not available for study, and valid publication of this epithet in the genus *Dryopteris* could not be verified. The name is probably a misspelling of *Dryopteris clintoniana* (which see).

"Dryopteris coreano ssp. montana," Hort.—Plants listed by this name were not available for study. The name is probably a misspelling for *Dryopteris coreano-montana,* a synonym of *D. sichotensis* (which see).

Dryopteris fructuosa (Christ) C. Chr. (Index Filicum 267. 1905).—Plants listed by this name were not available for verification. The name represents a variable fern with markedly leathery, glossy, dark green fronds to ca. 100 cm long, 2-pinnate to 2-pinnate-pinnatifid at the base. This native of the Sino-Himalayan region belongs to the section *Pallidae.*

Dryopteris guanchica Gibby & Jermy (Bot. J. Linn. Soc. 74:258. 1977).—Plants listed by this name were not available for verification. The name represents a plant with concolorous rhizome scales and proximal pinnae with the basal acroscopic pinnules usually shorter than the next. This native of the Canary Islands belongs to the section *Lophidium.*

Dryopteris koidzumiana Tagawa (Acta Phytotax. Geobot. 2:190. 1993).—This name refers to an evergreen fern similar to *D. erythrosora* with few scales, narrower pinnules with dentate margins, incurved teeth, and larger sori. The attractive red new fronds last longer than in *D. erythrosora.* Plants were intro-

duced from Yakushima, Japan, by the senior author and spores were distributed to growers. This native of Japan belongs to section *Erythrovariae.*

"Dryopteris megalodus," Hort.—Plants listed by this name were not available for study and the name, which could not be verified as validly published, is of uncertain application.

Dryopteris munchii A.R. Sm. (Proc. Calif. Acad. Sci., ser. 4, 40:218. 1975).—Plants listed by this name were not available for verification. The name represents a fern with triangular fronds to ca. 100 cm long, nearly 3-pinnate; the stipe and rhizome scales are tan with dark heavy streaks. It is native to Chiapas, Mexico, and belongs to the section *Cinnamomeae* Fraser-Jenk. (not treated or keyed above), which is characterized by having fronds 1- to nearly 3-pinnate, lanceolate to narrowly triangular, thinly herbaceous, brittle, and the pinnules markedly obliquely sloping.

Dryopteris namegatae (Sa. Kurata) Sa. Kurata (J. Geobot. 17:89. 1969).—Plants listed by this name were not available for verification. The name represents a fern native to Japan and China that may be a hybrid between *D. cycadina* (*D. atrata*) and *D. dickinsii* (see treatment of *D. kuratae*), both belonging to section *Hirtipedes.*

Dryopteris odontoloma (Bedd.) C. Chr. (Acta Horti Gothob. 1:59. 1924).—Plants listed by this name were not available for verification. The name represents a fern with fronds to ca. 65 cm long, elongate triangular-lanceolate, 2-pinnate, with the pinnae markedly cordate at their base and small submarginal sori (to 1 mm diameter). The species is in section *Pallidae.*

Dryopteris pacifica (Nakai) Tagawa (Coloured Illustrations of the Japanese Pteridophyta, 100, 211; plate 36, figure. 204. 1959).—*Dryopteris varia* (L.) Kuntze var. *hikonensis* (H. Itô) Sa. Kurata.—This species is currently being grown from spores by commercial and amateur growers. It is an evergreen, medium-size fern with dark green, glossy, triangular fronds to 3-pinnate and is classified in section *Variae.* The stipe scales are usually all blackish brown or black, the segment margins are flat, and the pinnae generally do not overlap. The indusium margin is sometimes ciliate. It is similar to *D. bissetiana,* but the latter has reflexed segment margins.

Dryopteris pacifica maybe confused with *D. sacrosancta,* but the latter has stipe scales with pale margins, lighter green fronds that are dull or hardly shiny, pinnae that tend to overlap, and indusia with entire margins. *Dryopteris pacifica* is evergreen and reportedly hardy in USDA zone 6 (average annual minimum temperature 0 to −10°F). It tends to be a more compact growing plant than *D. sacrosancta.* Some of the plants from which spores have been distributed in the U.S. were collected in Yakushima, Japan, by the senior author. The species is native to Japan, Korea and China. In Japan, it grows in areas with a minimum January average temperature of 30°F or warmer.

Dryopteris paleacea (T. Moore) Hand.-Mazz. (Verh. K. K. Zool.-Bot. Ges. Wien

58:100. 1908).—Plants listed under this name were not available for verification. The name is a synonym for *D. wallichiana* (section *Fibrillosae*) and plants in the trade may represent that species (which see).

Dryopteris sordidipes Tagawa (Acta Phytotax. Geobot. 3:29. 1934).—This is an evergreen ca. 50–90 cm tall and reminiscent of *D. dilatata* except firmer and more coarsely cut. About 20 years ago, the name appeared in a Chicago catalog. This listing was not verified. The senior author made a recent introduction from Yakushima, Japan, and spores have been distributed to growers. The species is native to Japan and Taiwan and belongs to the section *Variae*.

Dryopteris yigongensis Ching in C.Y. Wu (Fl. Xizangica 1:253. 1983).—Plants listed by this name were not available for verification. The name represents a fern with glossy fronds to ca. 50 cm long, narrow triangular-lanceolate, to 2-pinnate at the base and with long stipes bearing black, glossy scales. A native of the Sino-Himalayan area, it belongs to the section *Fibrillosae*.

Dryopteris villarii (Bell.) Woyn. ex Schinz & Thell. (Vierteljahrsschr. Naturf. Ges. Zürich 60:339. 1915).—Plants listed by this name were not available for verification. Cultivated materials may represent *D. mindshelkensis* (which see), a tetraploid that has *D. villarii* as one putative parent. The species belongs to the section *Pallidae*.

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